AC

DRAFT ENVIRONMENTAL IMPACT STATEMENT

LIVESTOCK GRAZING MANAGEMENT ON NATIONAL RESOURCE LANDS

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DECEMBER 17, 1973

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SUMMARY

(x) Draft ( ) Final Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action: (x) Administrative ( ) Legislative

2. Brief description of the proposal:

The proposal is to manage livestock grazing on 140 million acres of the national resource lands consistent with the multiple-use goals identified on specific geographic areas through the process of the Bureau's planning system. This would entail the management of livestock grazing through the application of grazing systems to improve rangeland conditions for watersheds and wildlife habitat, and provide a sustained yield of livestock forage consistent with environmental protection and enhancement. About 20,000 livestock operators and approximately 13 million animal unit months annually are involved. It is intended that the proposal be implemented over a period of 16 years culminating in 1990.

3. Summary of environmental impact and adverse environmental effects:

(A) A renewable resource (vegetation) will be harvested under a sustained yield concept. Quality and quantity of vegetation will be improved for wildlife, watershed protection, livestock forage, and aesthetic quality. Degradation trends with respect to soil conditions, water quality, and vegetative composition will be reversed.

(B) Competition for forage and habitat will continue between livestock, wildlife, and wild horses and burros.

(C) Fences, water development facilities and certain land treatment practices required to implement the proposal will have aesthetic and environmental impacts.

(D) Economics and social stability of dependent rural communities will be enhanced.

(E) Federal expenditures will increase over present levels and in excess of receipts from collected fees.

4. Alternatives considered:

(A) Continue the present program of livestock grazing.
(B) Removal of livestock grazing from national resource lands.
(C) Permit livestock grazing for maximum livestock production on the national resource lands.

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5. Comments have been requested from the following:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Atomic Energy Commission
- Department of the Interior
  - Bureau of Indian Affairs
  - Bureau of Sport Fisheries and Wildlife
  - Bureau of Outdoor Recreation
  - Bureau of Reclamation
- State Clearing Houses
  - State of Arizona
  - State of California
  - State of Colorado
  - State of Idaho
  - State of Montana
  - State of Nevada
  - State of New Mexico
  - State of Oregon
  - State of Utah
  - State of Wyoming

6. Date draft made available to CEQ and public:

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PART I

DESCRIPTION OF THE PROPOSED ACTION

Purpose

This draft environmental statement for livestock grazing management has been prepared in accordance with Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4327). This is a programmatic statement relating to the livestock grazing management program administered by the Bureau of Land Management (BLM) and analyzes the environmental impact of livestock grazing management proposed for the national resource lands (NRL), formerly known as the public lands or public domain.

This statement will provide a broad description of, and the alternatives to, the proposed livestock grazing management program, and their impacts on the environment. It will also serve as the foundation for subsequent environmental analyses and statements that may be required. It will identify factors needing close attention in such analyses to obtain definitive information.

Scope

The statement is limited to actions on the NRL in the following states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, South Dakota, Oregon, Utah, Washington, and Wyoming.

Feasibility of Proposal

The actions necessary to implement the livestock grazing management proposal are based on (a) completion of the Bureau planning system including the establishment of multiple-use goals for a specific geographic area, and (b) provisions of necessary funds and manpower resources to implement the proposal by 1990. The assumption is made that accomplishment of both items is possible, although obviously, long-term commitment of budgetary resources by the Department of the Interior and the Bureau of Land Management is subject to executive and legislative review. Some of the actions required to implement the proposal are being taken as part of the current livestock grazing program.

Proposed Action

The proposal is to manage livestock grazing on approximately 140 million acres of NRL consistent with the multiple-use goals identified on specific geographic areas through the process of the BLM planning system. This would entail the management of livestock grazing through the application of grazing systems so as to improve rangeland conditions for watersheds and wildlife habitat, and provide a sustained yield of livestock forage consistent with environmental protection and enhancement. The proposal is intended to be implemented by 1990.

Description of the Proposed Action

The planning system identifies the compatibility of livestock grazing with the other resource uses and the extent to which livestock grazing will take place in a geographic area. The actions necessary to achieve this desired management of livestock grazing are documented in an allotment management plan (AMP). The AMP is a concisely written program of livestock grazing management prepared under direction of the BLM district manager including supportive measures, if required, designed to attain specific management goals in a grazing allotment. The AMP utilizes an interdisciplinary approach. (Refer to Appendix I-A for an example of an allotment management plan).

Management of livestock grazing may include any one, or any combination of the following practices:

1. Adjustment in numbers of livestock;
2. Changing season, frequency, or intensity of livestock use;
3. Changing class of livestock, i.e., sheep, cattle, horses;
4. Deferment of livestock use;
5. Rotation of livestock use;
6. Rest from livestock use;
7. Improved distribution of livestock use;
8. Removal of livestock, temporarily or permanently, from areas within a grazing allotment where livestock grazing is not compatible with other resource values and uses.

Development of a prescribed grazing system may include one or several of the preceding practices. For example, a grazing system designed to achieve proper livestock grazing management may require a reduction in numbers of animals, changing class of livestock from sheep to cattle, rotation of livestock grazing use, or removal of livestock entirely from a part of the area in order to protect critical wildlife habitat. The key to successful implementation is that any grazing system must be designed to provide for the continuing physiological needs of the vegetation.

The ecological basis for the application of grazing systems on NRL is supported by the potential that exists for improving range condition. The declining condition of millions of acres of rangelands caused by overgrazing during the past century sets the stage for needed improvements.

Scientific research shows that overgrazing has been so widespread that a lessening of grazing intensity or shortening of season of use commonly leads to appreciable improvement (1).

Overgrazed ranges will improve more rapidly with proper livestock grazing than with no livestock grazing (2). Livestock can be used to trample seed into the soil thereby promoting better soil cover and more forage; to remove by grazing stifling old growth on plants thus increasing plant vigor and production of usable herbage; to stimulate adventitious growth and higher quality forage; and to reduce fire hazard.

The supportive measures required to achieve the management goals consist primarily of fencing and water development. Other supportive measures may include land treatment practices (spraying, seeding, brush removal, etc.) and some construction of roads and trails. Refer to Table I-1, for a tabulation of existing and proposed supportive measures.

Table I-1

Existing Status and Estimated Quantity of Supportive Measures Required to Fully Implement the Proposed Program

Type of Supportive Measure	Existing Quantity	Needed Quantity	Total
Fences	28,000 miles	99,000	127,000
Water Developments			
Springs	5,470 each	5,300	10,770
Pipelines	4,300 miles	16,500	20,800
Wells	2,700 each	6,500	9,200
Reservoirs	16,000 each	25,000	41,000
Land Treatment			
Chemical	1,706,000 acres	2,603,000	4,309,000
Mechanical			
Pinon-Juniper chaining	48,000 acres	686,000	734,000
Brush removal	201,000 acres	535,000	736,000
Plowing	2,026,000 acres	1,595,000	3,621,000
Prescribed burning	237,000 acres	530,000	767,000
Seeding	3,206,000 acres	2,900,000	6,106,000
*Roads & Trails			
Roads	6,300 miles	5,500	11,800
Trails	3,100 miles	4,050	7,150

*Also serve other resource use demands such as hunting, fishing, camping, prospecting, etc.

At the present time, the Bureau of Land Management administers 171,500,000 acres in the western United States. Approximately 14,000 livestock operators hold 15,700 licenses or permits to graze livestock inside 52 grazing districts. In addition, about 8,000 operators hold 8,300 separate leases outside grazing district boundaries. The combined total of licenses, permits and leases is 24,000. Grazing use amounts to approximately 3.5 million cattle and 5.6 million sheep consuming nearly 13 million animal unit months (AUMs) of forage annually. The existing livestock grazing program is discussed in detail under Alternative A in Part VIII. Refer to Table VIII-1 for the breakdown of existing livestock grazing use by state.

The proposed action will enable the NRL to contribute, through continuance of livestock grazing, to a variety of the nation's needs such as its red meat supply, numbers and variety of wildlife and quality water. This will be accomplished by using the grazing Allotment Management Plan concept within the framework of BLM's land use planning system.

The AMP is a concisely written plan for the management of livestock grazing within a multiple-use framework (including supportive measures if required) designed to attain specific multiple-use management goals in each designated grazing allotment. Steps in development of an AMP are as follows:

1. Preparation of a Management Framework Plan under the Bureau's planning system which involves:

   a. inventory of all resources and values;

   b. analysis of data to determine potential uses and conflicts among uses;

c. decision as to the use or combination of uses to be authorized within a specific area.

2. Preparation of an AMP as an interdisciplinary Bureau effort in cooperation with the livestock operator authorized to graze in the area, provided that grazing is identified in the MFP as a compatible use of the area. The AMP includes:

a. a statement of management objectives for all authorized uses in the area (including wildlife, recreation, minerals, etc.);

b. a system for management of livestock use designed to meet the stated objectives;

c. a system of monitoring the plan to insure compliance and measure progress toward meeting the objectives or identifying needed modication in the plan.

About 25 million acres of the NRL are presently managed under AMPs. The 1,015 AMPs that have been implemented represent an estimated 12 percent of the number (8,230) needing to be developed and implemented on the NRL.

Table I-2 shows by states the number of AMPs in force and the number written but not implemented because of inadequate funds to construct the necessary supportive facilities and insufficient manpower for supervision and monitoring.

Following adoption of the AMP program in 1965, the bulk of BLM's range management effort was directed at the AMP program. As the number of implemented plans increased, the workload for supervision and maintenance of these plans increased which reduced capability to develop and implement new AMPs. As a result, the AMP program has slowed considerably while the requests for AMPs from livestock operators have grown. Also during this time, acceptance of the program by game management agencies and conservation groups has increased.

The exact number of AMPs needed will not be known until the broad components of BLM's land use planning are completed; however, the following data indicate the best estimates available at this time:

AMPs estimated required on NRL	8,230
AMPs implemented through FY 1973	1,015
AMPs remaining to be implemented	7,215
Total BLM acres (excluding Alaska)	171,500,000
Acres estimated unsuitable for livestock grazing [1]	31,500,000
Acres suitable for livestock grazing	140,000,000
Small isolated tracts grazed in conjunction with private lands (no AMPs required)	7,000,000
Acres estimated needing AMPs	133,000,000
Acres with AMPs through 1973	25,000,000
Acres remaining at beginning of 1974 needing AMPs	108,000,000

Of these 108 million acres, about 20 million acres have an adequate level of livestock grazing management now and little change will take place in the type of management recommended as a result of the processes of the Bureau Planning System. Another 20 million acres are estimated to need only changes in season of use, class of livestock, and portions of

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[1] Of these 31,500,000 acres, it is estimated that 10 million acres are within existing livestock grazing allotments and are subject to grazing.

TABLE I - 2

STATUS OF THE AMP PROGRAM WITHIN THE BUREAU OF LAND MANAGEMENT

(June 30, 1973)

State	TGA 1/ Section	Implemented Plans	Acreage (1,000's)			Plans Complete-Not Implemented	Acreage (1,000's)			Grazing System Only	Acreage (1,000's)			Number of Firm Requests for AMPs
		No.	BLM	Other	Total	No.	BLM	Other	Total	No.	BLM	Other	Total	
Arizona	3	41	1,013	203	1,216	9	340	39	379	-	-	-	-	8
	15	2	40	17	57	1	8	25	33	-	-	-	-	-
	Total	43	1,053	220	1,273	10	348	64	412	-	-	-	-	8
California	3	16	269	45	314	-	-	-	-	4	49	17	66	4
	15	31	368	64	432	1	25	8	33	-	-	-	-	11
	Total	47	637	109	746	1	25	8	33	4	49	17	66	15
Colorado	3	74	1,007	249	1,256	15	282	39	321	1	1	-	1	98
	15	4	13	6	19	-	-	-	-	-	-	-	-	2
	Total	78	1,020	255	1,275	15	282	39	321	1	1	-	1	100
Idaho	3	82	1,987	473	2,460	14	586	65	651	2	76	10	86	121
	15	3	4	5	9	-	-	-	-	-	-	-	-	2
	Total	85	1,991	478	2,469	14	586	65	651	2	76	10	86	123
Montana 2/	3	139	1,262	616	1,878	32	318	123	441	7	40	1	41	75
	15	28	189	171	360	4	18	11	29	6	34	6	40	19
	Total	167	1,451	787	2,238	36	336	134	470	13	74	7	81	94
Nevada	3	87	5,071	601	5,672	16	1,357	108	1,465	2	28	3	31	94
	15	1	660	7	667	-	-	-	-	-	-	-	-	-
	Total	88	5,731	608	6,339	16	1,357	108	1,465	2	28	3	31	94

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Table I (continued)

State	TGA Section	Implemented Plans Acreage (1,000's)				Plans Complete-Not Implemented Acreage (1,000's)				Grazing System Only Acreage (1,000's)				Number of Firm Requests for AMPs
		No.	BLM	Other	Total	No.	BLM	Other	Total	No.	BLM	Other	Total	
New Mexico	3	140	2,159	838	2,997	56	1,051	528	1,579	7	44	9	53	55
	15	2	9	32	41	-	1	-	1	-	-	-	-	-
	Total	142	2,168	870	3,038	56	1,052	528	1,580	7	44	9	53	55
Oregon 3/	3	111	2,320	448	2,768	6	198	38	236	9	292	37	329	39
	15	15	71	181	252	-	-	-	-	4	45	164	209	7
	Total	126	2,391	629	3,020	6	198	38	236	13	337	201	538	46
Utah	3	163	6,929	1,130	8,059	53	1,757	352	2,109	2	159	14	173	21
	15	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	163	6,929	1,130	8,059	53	1,757	352	2,109	2	159	14	173	21
Wyoming	3	67	1,542	433	1,975	6	91	14	105	1	131	5	137	20
	15	9	146	114	260	1	24	4	28	1	1	1	1	4
	Total	76	1,688	547	2,235	7	115	18	133	2	132	6	138	24
Bureau Total		1,015	25,059	5,633	30,692	214	6,056	1,354	7,410	46	900	267	1,167	580

1/ Taylor Grazing Act - Section 3 - lands inside Grazing District boundaries
Section 15 - lands outside Grazing District boundaries

2/ Includes states of North Dakota and South Dakota

3/ Includes state of Washington

allotments excluded from livestock grazing. The remaining 68 million acres will require management actions involving more detailed grazing systems. Grazing on the seven million acres of isolated tracts, normally located outside grazing district boundaries, would be administered on a custodial program subject to environmental safeguards to protect the public interest.

The criteria for developing and implementing AMPs will focus on improving watershed conditions. However, this may involve any number of considerations emerging from the land use planning effort and also on the availability of manpower and funds. Included in this criteria are: (a) potential for improving the watershed is clearly identifiable; (b) allotments where grazing reductions are eminent and the purpose of the AMP would be to prevent the need for reduction in livestock use; (c) critical wildlife habitat is deteriorating and the AMP will include a grazing system with specific objectives for improving wildlife habitat; (d) increasing livestock forage production; (e) protecting and improving fisheries habitat; and (f) availability of private funds to invest in range improvements that are necessary components of the AMP.

Although certain rangelands will continue to deteriorate during the interim period, implementation of the proposal by 1990 will result in a reversal of declining trends. As indicated by the 1964 range condition and trend data in Table I-3, page I-11 about one-fourth of these grazing lands are in poor to bad condition and about 12 percent in a declining trend.

Table I-3 also projects range condition and trend data that can be expected for each major biome by implementation of the proposal.

Table I-3

Estimated Forage Conditions as a Result of the Proposal Projected to 1990 and 2000. [1] (Data derived from literature citations 7-16, page I-25).

Biome and Grazable Acres		Percent in Condition Class		
		Good	Fair	Poor
Grassland				
18,080,000	1964	31	53	16
	1972 [2]	48	45	7
	1990	60	36	4
	2000	64	33	3
Desert				
90,476,000	1964	13	51	36
	1972 [2]	12	54	34
	1990	32	52	16
	2000	40	50	10
Woodland-Bushland [3]				
29,779,000	1964	14	53	33
	1972 [2]	5	47	48
	1990	8	51	41
	2000	8	53	39
Coniferous Forest				
10,582,000	1964	24	57	19
	1972 [2]	45	45	10
	1990	57	37	6
	2000	63	33	4

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[1] These estimates are made on the basis of benefits derived from improved grazing management only and do not include additional benefits to forage conditions resulting from mechanical and chemical treatment or prescribed burning.

[2] Data adapted from Forest Resource Report No. 19, The Nations Range Resources, Forest Service, U.S.D.A. 1972. 147 p.

[3] Little improvement can be expected without supplemental mechanical and chemical treatment, or prescribed burning in this biome particularly.

Application of grazing systems through implementation of additional AMPs would be a process extending over a period of time proposed to culminate by 1990. On the average, an investment of about $30,000 will be required for developing and implementing an AMP. An estimated $4,500 of private funds, primarily from range users, would be associated with each AMP. Beyond the investment period, an estimated annual maintenance cost of $1,500 per AMP is anticipated. The degree of cost sharing between federal and private sources will be guided by the proportion of public and private benefits generated from AMP implementation.

The Taylor Grazing Act of 1934 authorized the Secretary of the Interior to charge a grazing fee for the use of the range. The Secretary can establish the amount of that grazing fee inside grazing districts which, when appropriated by Congress, shall be expended for the range improvement program. 2/

Grazing fees established for the use of the NRL varied from a few cents per animal unit month (AUM) in 1935 to 33 cents in 1968 when the present grazing fee schedule was implemented. The schedule resulted from a joint Department of Agriculture-Department of the Interior study in 1966 to establish a grazing fee for the public lands based on fair market value (FMV). That study found the FMV to be $1.23 per AUM.

The grazing fee is scheduled for annual increments of nine cents until 1980 when the FMV adjustment will be fully implemented. In addition,

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2/ On grazing lands outside district boundaries the Secretary of the Interior is required by Section 10 of the Taylor Grazing Act to designate, when appropriated by the Congress, 25 percentum of the grazing fees collected for range improvements.

an annual adjustment (plus or minus) is made to reflect the private forage value index.

The 1974 grazing fee of $1.00 per AUM represents an increase of 22 cents over the 1973 grazing fee. Of the 22 cents increase, nine cents is scheduled annual increment and 13 cents is the increase in the forage value index.

The range improvement portion of the 1974 grazing fee of $1.00 per AUM will be 40 cents per AUM inside grazing districts. Based on 10 million AUMs of forage inside the districts, approximately four million dollars will be designated for range improvements in 1975. The range improvement fund derived from 25 percent of the grazing fees on approximately three million AUMs outside grazing districts will add about $750,000 to this amount.

The increase in grazing fees with full implementation of the grazing fee schedule in 1980 is projected at $1.95 per AUM. The designation of a significant amount of the fee for range improvements will assist funding the proposed action.

The proposal of intensive livestock grazing management is premised on grazing use adjusted to the rangeland carrying capacity (or available forage) as determined by range studies. Consequently the grazing fee has no effect on environmental impact by livestock grazing. Also, there is no basis to assume there would be a reduction of grazing use as a result of grazing fees set at fair market value. The increased demand for livestock products will fully commit the available range forage supply.

Based on the Bureau's brief experience with the AMP program, it is estimated that livestock forage can be increased a minimum of 3.5 million AUMs by implementing the proposal. Experience in the Winnemucca District of Nevada shows an increase of 17,000 AUMs (20%) of livestock forage and greatly improved watersheds and wildlife habitat over a period from 1965-1971 on allotments with AMPs.

Table I-4 reflects AUMs of forage for livestock, wildlife, and wild horses and burros that can be expected by implementing the proposal.

Table I-4

Present Status and Projected Total Animal Unit Months (AUMs) of Forage for Livestock, Wildlife and Wild Horses and Burros as a Result of Fully Implementing the AMP Program.

		Animal Unit Months	
Class of Animal	1972	1990	2000
Livestock	13,000,000	16,500,000	18,700,000
Wildlife [1/]			
Antelope	182,000	214,000	240,000
Deer	1,647,000	1,945,000	2,175,000
Elk	277,000	326,000	365,000
Bighorn Sheep	15,500	18,200	20,400
*Other Mammals	21,000	24,700	27,700
Wild Horses	**760,000	760,000	760,000
Wild Burros	** 47,500	47,500	47,500
Total	15,950,000	19,835,400	22,335,600

[1/] Converted to livestock AUMs

* Includes only recognized game species.

** Based on 1971 estimates.

History and Background

Before the European settlers arrived in the western United States, natural ecosystems existed throughout the area. Within these ecosystems were large herds of herbivores such as bison, antelope, deer, and elk. There were no man-made barriers to restrict their free movement and, as a consequence, these animals migrated at will. When food or water became scarce in an area or seasonal climatic changes dictated, the animals moved to a new range. This freedom of movement provided periodic rest for the vegetation that had been grazed. These rest periods allowed the plants to regain their vigor and complete other life-sustaining growth processes; thus the ecosystems evolved under grazing and changed very little.

The ecosystems of the western United States have developed under grazing and trampling pressure of ungulates that have consistently been a component of these ecosystems. During the exploration period of the West, the western rangelands were recognized as having a great potential for livestock production. As a result, many large-scale livestock operations created significant vegetative changes in the range ecosystems that were to increase in subsequent years. The transition from wildlife to domestic livestock upset the natural ecosystem, not because of the difference in the grazing animals, but because of the increased numbers, wrong seasons of use, confinement, and losses in available grazing areas caused by homesteading, urban expansion, and other development.

During the 19th and 20th centuries, as the human population increased and settlement expanded westward, numbers of livestock in the West also increased replacing the native herbivores in the ecosystem. Wildlife populations were sometimes deliberately decimated to reduce their competition with sheep or cattle and also to eliminate food sources of those Indians dependent on wildlife for their existence.

The range ecosystems that once supported an incredibly vast number of large herbivores as well as smaller wildlife forms underwent some drastic changes in vegetation composition because of the grazing habits and the confinement of the domestic livestock within man-made barriers. In addition, thousands of acres of the range ecosystems were being converted to farmland, thereby significantly reducing the size of the original range ecosystems. For example, nearly 200 million acres of the tall grass prairie were converted.

Through the various activities of man, many ecosystems underwent deterioration because of the loss of the productive topsoil through accelerated wind and water erosion. By 1900, the productive capacity of the area that was to become the NRL of today had been greatly reduced (3).

The expansion of the railroads into the western United States helped supply increased demands for meat in the East. The railroads expanded the marketability of western beef and increased the interest in livestock production on western rangelands.

During this period, there was a growing concern among the users of the western rangelands over the destructive use being made of the lands (4). Migrant sheep herds were moved from range to range and were often in direct competition with local sheep and cattle for forage on the national resource lands. The local stockmen, through homesteads and other land and water aquisitions, had established operations with designated geographic areas and attempted to exert control of the national resource lands through registration of water rights, herding laws, and the like (5). Insufficient rangeland and inadequate forage production failed to sustain the livestock industry that had developed. During this period the level of knowledge about man's impact on range ecosystem was lacking. Related research was nonexistent.

Rangeland conditions became critical during the early 1930's, and in 1934, the Taylor Grazing Act was enacted by Congress. The purpose of this Act was to stop injury to the national resource lands resulting from unrestricted grazing; to provide for their orderly use, improvement and development; and to stabilize the livestock industry depending on the national resource lands.

To implement the Taylor Grazing Act, a Division of Grazing was established within the Department of the Interior. Regulations to put the Taylor Grazing Act in force became known as the Federal Range Code.

The initial job of the 47 field personnel in the Grazing Service was to divide the national resource lands for use by qualified livestock operators in accordance with recognized grazing qualifications. There was little attempt during this period to adjust grazing use to the ability of the land to sustain grazing. The extent of the grazing privileges issued was based primarily on the use made by the livestock operator during the five years prior to the passage of the Taylor Grazing Act and on the applicant's control of either private land or water.

There was little broad public interest in the condition of western rangelands at this time. Minimal congressional funding to implement the Taylor Grazing Act was proof of this public apathy.

The Grazing Service and the General Land Office were combined to form the present Bureau of Land Management (BLM) in 1946.

Increasing awareness of resource management needs, as a result of studies revealing the extent of poor condition of the land, led to increasing emphasis for better management. By 1950, appropriations had increased sufficiently to allow BLM to hire additional professional range conservationists for the range management program. Inventory of the range forage resource began for the first time which enabled the range manager to calculate the number of livestock that could properly graze an area.

Based on these studies, ranchers were allocated certain areas with a given number of animals during a given season of use. These decisions often conflicted with the rancher's historic use of the range and required a reduction in livestock use, which did not always stop range deterioration. This range adjudication process often resulted in lengthy legal proceedings during which the grazing continued.

In 1964, Congress demonstrated its intent to have the NRL managed under the multiple-use concept by passing the Classification and Multiple-Use Act of 1964 (78 Stat. 986). This Act directed the Secretary of the Interior to establish criteria by which he would determine which lands administered by him through the BLM will be disposed of, or retained in federal ownership and managed for their multiple-use values, including: (a) domestic livestock, (b) fish and wildlife, (c) industrial development, (d) mineral production, (e) occupancy, (f) outdoor recreation, (g) timber production, (h) watershed protection, (i) wilderness preservation, and (j) preservation of public values. For the first time Congress clearly indicated that some NRL should be retained in federal ownership. Figure I-1

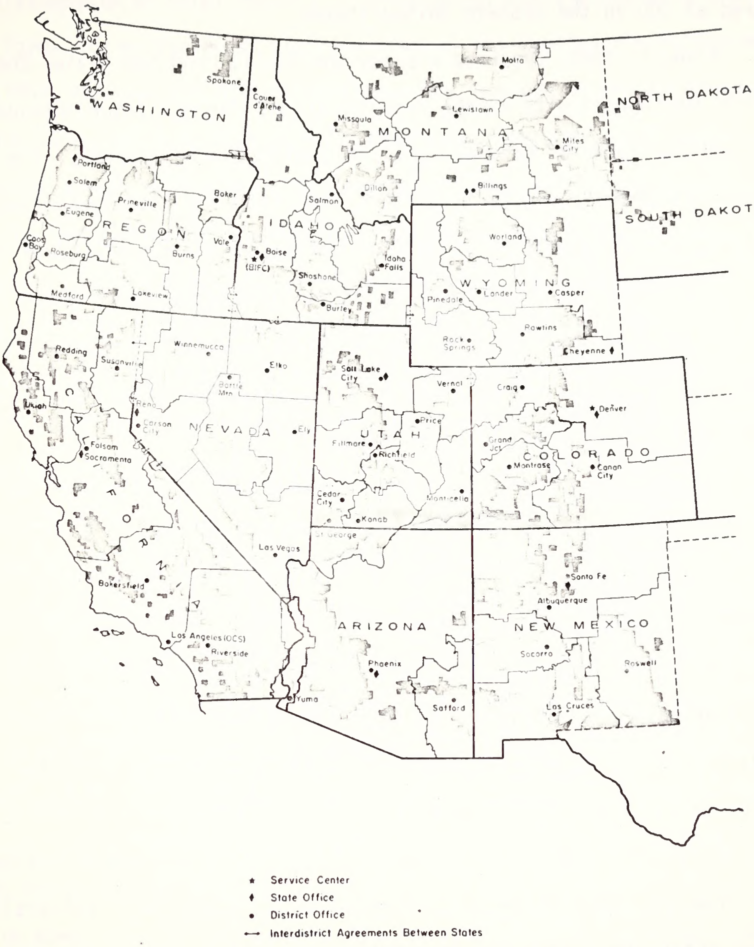

Figure I-1. National Resource Lands Administered by the Bureau of Land Management

shows the location of the principal concentrations of the 171,500,000 acres of NRL in the western United States.

Also, in 1964, Congress created the Public Land Law Review Commission which was charged with making recommendations for the future management of 725 million acres of federal lands, including all of the NRL. The Commission Report, delivered in 1970, contained 137 recommendations of which nine were specifically directed at new policy and direction for the future management of livestock grazing on the federal lands under study (6). All of the nine recommendations contemplated continued use of the federal lands for livestock grazing, but so far no legislation has been passed to implement the livestock grazing recommendations.

By 1965, the majority of range adjudications were complete and BLM management efforts were directed toward the development of a more intensive form of livestock grazing management. This was the beginning of the Allotment Management Plan program.

The grazing management program of BLM represents only one activity or use that may be occurring at the same time in the same area. Each area may, in addition to grazing, include mineral operations, watershed management, wildlife management, recreation, timber management and public uses such as utility right-of-way, sanitary land fills, and communication sites. Individually, each use produces impacts on the ecosystem. Collectively, these activities could produce a total effect that exceeds the ecosystem's capacity to sustain itself, or to recuperate.

Criteria exist for measuring such items as the carrying capacity of a livestock range or the allowable cut of a forest. Fragmented analyses of individual resource activities have little meaning, however, unless their relationship to total impacts is understood, and the analyses are used to formulate multiple-use programs that do not overtax the ecosystem.

In 1964, BLM started developing a planning process to better determine which land use, or combination of land uses, can take place on an area. After a period of design and testing, the BLM planning system was adopted and implementation started in July, 1969. This system is presently being used to develop and maintain land use plans which consider all of the various resource uses for all national resource lands.

The BLM planning system is similar to traditional planning approaches. It includes such usual components as goals, objectives, inventory of physical resources, socio-economic data, and public participation. However, it differs in several ways. It has techniques requiring the description and comparison of "trade-off", and what is gained or lost when decisions are made to accept various alternatives. Another major departure from traditional planning philosophy is the concept and requirement of assessing the single-use potentials of each physical resource.

In brief, the system works as follows (for detail refer to BLM Manuals 1601-1608). The first step in the procedure is to delineate the BLM-administered land into geographical areas called planning units. These units serve as the basis for collection and analysis of basic resource inventory data. In some cases, the planning units are combined into planning areas for purposes of preparing the management framework plan (MFP). Under the BLM system the MFP is the land use plan. Unit resource analyses (URA) are prepared for each planning unit. The URA includes a detailed description of the existing environment of the planning unit, a physical inventory of individual resources (lands, minerals, livestock forage, forestry, recreation, wildlife, watershed), and an analysis of the resource production opportunities without multiple-use consideration.

After URAs are completed, an MFP is prepared for a planning area. This area may cover one or more planning units. Basically, the MFP is the result of a process designed to identify and reconcile major land and resource use conflicts. The MFP provides a set of goals, objectives, and constraints for a specific planning area to guide the development of detailed plans for the management of each resource. It is prepared using an interdiciplinary approach at the field level by BLM employees. Coordination with a variety of groups and interests is obtained in an organized public participation process.

Since 1969, MFPs have been completed on about 25 percent of the national resource lands. MFPs are estimated to be completed on all NRL by 1980.

The MFP for a specific planning area describes the various resource uses that are permissible after consideration of BLM policy guidance, the facts about the resources and uses, views of the public, and other inputs to the decision-making process. In addition, the MFP describes the constraints on planning necessary to ensure compatibility of uses, protection and enhancement of the environment, and other management objectives.

The MFP process requires three steps. Step 1 is the development of a set of recommendations showing the optimum use and/or development for each resource, constrained only by the resource capability, the limiting effects of policy, and social and economic data as provided by other components of the planning system. Step 1 also includes environmental enhancement and protection recommendations. Step 2 covers conflict resolution and development of alternatives to solve or minimize the conflicts. This step makes alternative multiple-use recommendations for the planning area, thereby resource use conflicts are resolved and constraints are established to guide management of each resource. The final step involves the decision-maker's selection of a set of alternatives to guide future programs. The decision-maker is guided by policy and public views. Public involvement in developing MFP occurs at all steps, beginning with URA.

BLM policy is that significant changes in grazing management will not be made until the MFP is completed. This is to allow proper consideration of other resource values. However, where environmental analyses or studies indicate areas are deteriorating significantly due to improper livestock grazing, or because of drought, practices or decisions needed to halt resource degradation may be implemented at once. These actions are not restrained by completion of planning except that irreversible actions to halt deterioration will not be taken without an MFP.

To illustrate, current grazing management will be subject to review as MFPs are completed. The following are some guidelines which could result from an MFP: Grazing boundaries could be adjusted; allotments could be consolidated or eliminated in such areas as frail land or important wildlife habitat; leases could be eliminated; areas could be identified as unsuitable for grazing because of soil damage or conflicts with an intensive recreation use; or forage production could be increased.

Following approval of the MFP by BLM, and subject to available funds and manpower, program activity plans are prepared for each resource activity, to lay out in detail how each activity will achieve the objectives and meet the constraints shown in the MFP. The program activity plan for grazing management is the AMP. The BLM planning system represents the process by which many of the mitigative measures described in Section IV are prescribed for use in any particular area.

The BLM's authority to administer the grazing program on the national resource lands is as follows:

a. Taylor Grazing Act. The Act of June 28, 1934 (48 Stat. 1269; 48 U. S. Code 315, as amended).

b. O. and C. Act of 1937 (50 Stat. 874; 43 U. S. Code 590a 118).

c. Soil Conservation and Domestic Allotment Act (Act of April 27, 1935, as amended; 16 U. S. Code 590a-590q-1 (1964 and Supp IV 1965-1968)).

d. Bankhead- Jones Farm Tenant Act (Act of July 22, 1937, 7 U. S. Code 1010-13a, 1964).

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PART II

DESCRIPTION OF THE ENVIRONMENT

Grazing of domestic livestock affects the surface environment. The impact of grazing on the surface environment depends largely on the ecological relationships that have developed in the area. The surface environment is described for each of the four major biological communities, or biomes, in the western United States. The locations of the biomes are shown in Figure II-1.

This statement relates only to national resource lands within each biome. The extent of livestock grazing on NRL within a biome will depend on the amount of NRL in the biome, the type and amount of the vegetation available for forage, and the demand for livestock forage.

Biomes are major biotic communities, or natural groups of organisms, characterized by certain "dominant" and "influent" plants and animals (1). Four major biomes were outlined for this statement.[1/] An attempt has been made to indicate the boundaries between the biomes. However, the biomes are really separated by transitional zones, or ecotones, where elements of adjacent biomes blend.

The four biomes described in this statement include both aquatic and terrestrial communities. They also contain biological islands more charac-

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[1/] International biome programs (IBP) have been initiated to analyze basic ecosystems of three of the biomes delineated in this statement. One of the goals of the IBP is to maintain or improve environmental quality.

teristic of other biomes. The islands are caused by geographical, climatic, altitudinal, and other variations within the broad areas delineated on the maps.

The present soil erosion classification ratings for the NRL are shown in Appendix II-A-1. These data are presented by the major vegetative types rather than by biome because of the islands of one biome within another biome. Because of the ecological differences, the livestock grazing impacts in these biological islands may be different from those described for the surrounding biome.

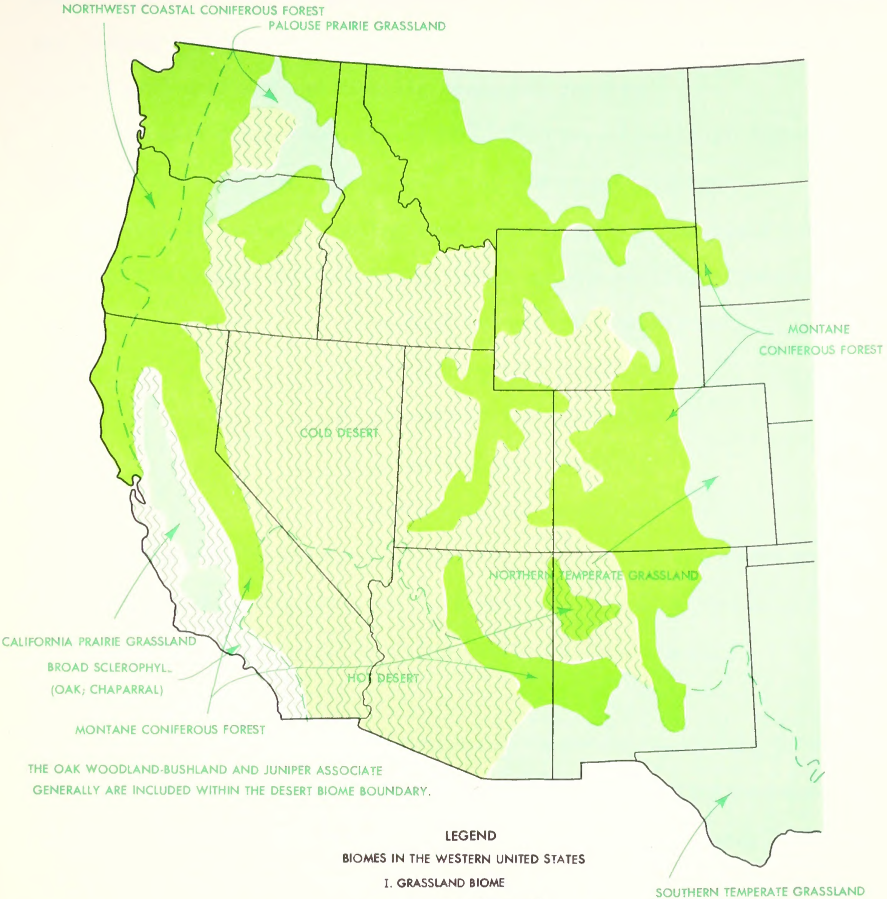
The present range condition classification by biome is detailed below. Appendix II-A-2 shows the range condition classification of NRL by state based on 1964 data.

Overview of the Four Biomes

The four major biomes described in this statement are the (a) grassland, (b) desert, (c) woodland-bushland, and (d) coniferous forest. Only two of the sub-biomes of the coniferous forest biome will be discussed. These are the northwest coastal and the montane coniferous forest subregions. The broad characteristics of the biomes are summarized below. More detailed descriptions are included in the following sections of Part II.

Grassland Biome

Grasslands occur where precipitation is too low to support forest life forms, but higher than that resulting in desert life forms. Soils are quite diverse, reflecting characteristics of the underlying parent material; they contain large amounts of humus. The larger forms of both native and


NORTHWEST COASTAL CONIFEROUS FOREST
PALOUSE PRAIRIE GRASSLAND
MONTANE CONIFEROUS FOREST
COLD DESERT
NORTHERN TEMPERATE GRASSLAND
HOT DESERT
CALIFORNIA PRAIRIE GRASSLAND
BROAD SCLEROPHYLL (OAK; CHAPARRAL)
MONTANE CONIFEROUS FOREST
THE OAK WOODLAND-BUSHLAND AND JUNIPER ASSOCIATE GENERALLY ARE INCLUDED WITHIN THE DESERT BIOME BOUNDARY.
SOUTHERN TEMPERATE GRASSLAND

LEGEND

BIOMES IN THE WESTERN UNITED STATES

I. GRASSLAND BIOME
  1 Temperate Grassland 🟩
  2 Palouse Prairie Grassland 🟩
  3 California Prairie Grassland 🟩

II. DESERT BIOME
  1 Cold Desert 🟩
  2 Hot Desert 🟩

III. WOODLAND-BUSHLAND BIOME
  1 Broad Sclerophyll
  2 Oak Woodland-Bushland* ‹‹
  3 Juniper Associates* ‹‹ ‹‹

IV CONIFEROUS BIOME
  1 Northwest Coastal Forest 🟩
  2 Montane Forest 🟩

(*Generally included within the desert biome boundary.)

FIGURE II-1 BIOMES OF THE WESTERN UNITED STATES (1)

domestic grazing animals are dominant. A large proportion of the mammals are running or burrowing types (2). Much of the grassland is used for agricultural cropland and domestic livestock grazing.

Within this biome there are 18,080,000 acres of national resource lands, all of which are considered to be usable by livestock.

Information derived from the 1964 range condition and trend survey, which is the latest data available, indicates the following condition:[2/]

2 percent in excellent condition
29 percent in good condition
53 percent in fair condition
14 percent in poor condition
2 percent in bad condition

There were 2,214,000 acres of the NRL in the grassland biome with an improving trend, 2,726,000 acres in a declining trend, with the balance of 13,140,000 usable acres in an indefinite or static trend.

Desert Biome

Deserts are shrub-vegetated ecosystems generally occurring in regions with less than 10 inches of annual precipitation and marked extremes in weather. The vegetation is adapted to aridity, and bare earth is common; little humus is formed. Hot deserts generally are warm throughout the year and very hot in summer. The cold desert is very cold in winter. Animals are adjusted physiologically or in habits of life to tolerate the arid environment (3). Most of the area remains essentially in its native vegetative state and is used primarily for livestock grazing. Outdoor

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[2/] Range condition and trend data is based on acres usable for livestock grazing. Present plans call for an updating of the range condition and trend data in fiscal year 1975.

recreation is an increasingly important land use in the biome. Within this biome there are about 102,720,000 acres of national resource lands of which 90,476,000 are considered usable by livestock. Information derived from the 1964 range condition and trend survey indicates the following condition:

1 percent in excellent condition
12 percent in good condition
51 percent in fair condition
30 percent in poor condition
6 percent in bad condition

There were 15,405,000 acres of the NRL with an improving trend and 13,353,000 acres with a declining trend, with the balance of 61,718,000 usable acres in an indefinite or static trend.

Woodland-Bushland Biome (3)

Woodland-bushland communities generally occur as biological islands at higher elevations in the desert and grassland biomes or in ecotones, or transitional zones, between the desert or grassland biomes and the coniferous forest biome. Vegetative cover ranges from shrub species typical of the cold desert to brush and small tree species in areas with greater precipitation. A diversity of plant species and climatic conditions exists among the subregions of the biome. Animal populations are also diverse and include many small reptilian species, rodents, small predators, larger browsing mammals, and a wide range of bird species.

Predominant land uses in this biome are similar to those in the desert, grassland, or coniferous forest biome. Within this biome there are about 30,700,000 acres of NRL of which 29,779,000 acres are considered usable by livestock. Information derived from the 1964 range condition and trend survey indicates the following condition:

2 percent in excellent condition
12 percent in good condition
53 percent in fair condition
28 percent in poor condition
5 percent in bad condition

There were 5,062,000 acres of the NRL in the woodland-bushland biome with an improving trend, 4,169,000 acres in a declining trend, with the balance of 20,548,000 usable acres in a static or indefinite trend.

Coniferous Forest Biome

The coniferous forests contain a diversity of environments, species compositions, soils, resource products and land uses. Precipitation in most of the biome is high, and the forests have a great capacity for vegetative growth; they are used primarily for wood and water production. However, recreation is becoming an increasingly important use, and urban areas are encroaching on some forested areas. Much of the land surface in the biome is federally owned. Within this biome there are about 20,070,000 acres of NRL of which 10,582,000 acres are considered usable by livestock. Information derived from the 1964 range condition and trend survey indicates the following:

2 percent in excellent condition
22 percent in good condition
57 percent in fair condition
17 percent in poor condition
2 percent in bad condition

There were 1,887,000 acres of the NRL in the coniferous forest biome with an improving trend, 1,407,000 acres in a declining trend, with the balance of 7,288,000 usable acres in a static or indefinite trend.

General Environmental Characteristics of all Biomes

Grazing and Vegetation Relationship

The following discussion of the interrelationship of grazing and vegetation is largely quoted, with minor modifications, from Lewis (4).

Overgrazing by domesticated animals was one of the first destructive changes produced by man in his environment. Similar patterns of degradation have been observed on every continent (5,6,7). Widespread alarm over range deterioration resulted in the establishment of grazing studies in the western United States beginning in 1895 (8). The literature on the influence of grazing on plant succession of range lands was reviewed by Ellison (9). The effect of defoliation on individual plants was reviewed by Jameson (10). The process of rangeland deterioration induced by grazing is summarized in the following paragraphs.

Overstocking with grazing animals results in overuse of the vegetation and increased mechanical injury due to trampling and increased soil disturbance and compaction (11). Although slight disturbance of the habitat that occurs under normal stocking rates may diversify the habitat and make it more favorable for other herbivores, overstocking is destructive (12).

Overuse of a plant population by clipping or grazing results in reduction in root growth and smaller, less extensive root systems (13,14). Other effects from overuse are reduced rhizome production; reduction in labile carbohydrates, proteins, and other substances (15,16,17). Slower regrowth and reduced foliage and seedstalk production also result from plant overuse by grazing (9,10).

Plants selectively grazed are less able to compete for water and nutrients than those that escape grazing. Grazing animals select those plants and parts of plants that are most palatable and most accessible to them at a given time. They graze first in convenient areas near water, their bedgrounds, and loafing areas. Different kinds of grazing animals prefer different areas in a pasture and have a different order of preference for plant species at different seasons. The mechanism of herbage selection is not well understood. However, palatability appears to be related to succulence and sweetness which are directly related to high nutritional value (18). Other factors being equal, consumption is proportional to the availability. Plants escape grazing because of low palatability, presence of armor, short or very tall growth form, or because their life cycle is completed at a time other than the grazing season.

Plants resistant to grazing are damaged less by close use and thus are better able to compete for water and nutrients than those easily damaged by grazing. One characteristic that makes a plant more susceptible to grazing damage is attaining a height within reach of grazing early in the season (19,20). A high ratio of fruiting to vegetative stems, a lack of vegetative means of reproduction, a low capacity to tiller, slow regrowth following grazing, less extensive root system with a slower rate of root growth, lack of drought resistance, lack of adaption to the site, and a high susceptibility to parasites and disease are additional factors of plants which make them more susceptible to grazing damage (21).

With prolonged use, plant species that are susceptible to grazing damage and are selectively grazed (decreasers) will be weakened and replaced by those species that escape grazing or are more grazing-resistant (increasers). Those less palatable species and biotypes not selected by the grazing animals survive (22,23). As the decreasing plant species become smaller and less abundant, they are less actively sought by grazing animals, thus permiting some individuals of these decreasing species to remain for many years (24). As relative palatability and availability change, some of the increasers receive more grazing pressure, and thus are replaced by increasers less likely to be grazed and still more grazing resistant (25). As the integration of the plant community is destroyed, exotic plant species, or those not originally present except on disturbed areas, are able to invade and spread over the range (26). These invading species are usually capable of rapid migration, adaptable to a drier habitat, and either very resistant to grazing, or escape grazing. As the botanical composition changes under the impact of grazing, the delicate adjustment of interacting plant populations and their adaption to the environment is disrupted. Thus, overstocking that is not corrected produces overuse which, over a period of years, is reflected in changes in the kinds and amounts of vegetation (27). Range condition, determined by the degree of departure from the climax plant community, is a quantitative measure of the estimate of this departure (28,29). As a range deteriorates under one kind of grazing animal, it often becomes more desirable for herbivores with different grazing habits and different forage preferences. This may result in a change in populations of small mammals and invertebrates. Where extreme overuse is continued for many years over large areas in relatively dry climates, desert conditions may be induced.

The destructive changes in native ranges caused by overgrazing do not occur on well-managed grazed lands. The natural state in rangelands was reached and maintained under grazing. While Ellison found no published data proving the beneficial effect of grazing, he concluded that such evidence will likely be found (9). Under judicious management, grazing can stimulate tillering, maintain a high proportion of new leaves to older tissue, and accelerate nutrient cycling. If these advantages can be accomplished without reducing the competitive ability of the most productive plant species and without appreciable desiccation of the habitat, grazing can increase net primary production.

Uncontrolled populations of wild ungulates, lagomorphs, rodents, and grazing insects result in the same process of induced regression described above and are just as damaging to net primary production as overgrazing by livestock. Habitat destruction has been documented for deer in Utah and on the Kaibab Plateau in Arizona (30,31). Similar documentation exists for habitat destruction by the Gallatin elk herd in Montana (32).

Overgrazing and habitat destruction may be made more severe by competition between domestic animals and wild herbivores (33). In the trans-Pecos region of Texas, pronghorns grazing on a drought-stricken range heavily stocked with cattle and horses were forced to subsist almost entirely on three unpalatable browse species that were available on the depleted range. As a consequence, 57 percent of the herd died from malnutrition and tarbush poisoning (34).

Ecological Interrelationships

Ecological interrelationships deal with the interworkings between all living and nonliving components. Plant and animal communities and populations as a whole are regarded in relation to one another and to the total environment. The ecosystem is examined, with its interwoven energy and material pathways, the growth and interaction of its populations, their evolution and behavior, their environmental relations and feedback mechanisms, and the structure, functions and development of communities. These interrelationships are illustrated in a common food chain such as grass-cow-man.

Generally, more is known about the terrestrial community than the aquatic community. The cumulative and collective effects of population and disturbance of the aquatic community are not well understood.

Nutrient Cycles

Such elements as nitrogen, oxygen, phosphorus and potassium are essential elements in the maintenance of life on earth. These and other nutrients continuously circulate through the environment in fixed patterns, or cycles, and in the process are made available in various forms to man and animals (consumers). For example, nitrogen is recycled from plants (producers) to animals (consumers) to the atmosphere and back in the following process. Microorganisms (decomposers) convert organic material into inorganic ammonia, nitrites, and nitrate. The nitrate, if not taken up by other plants or stored in the soil, is then denitrified; and the nitrogen is returned to the atmosphere as gas, where it again is available to nitrogen-fixing plants. The nitrogen taken up by plants moves into the bodies of grazing animals principally as proteins and back into the soil as excreta or upon decomposition of the animal after death (see Figure II-2).

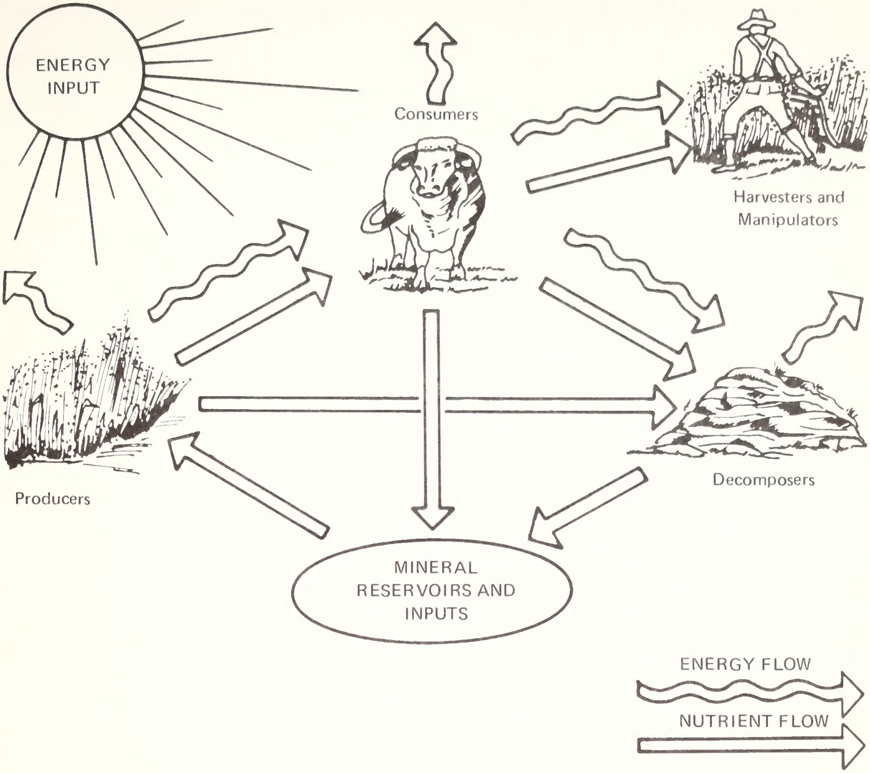

FIGURE II-2 A SCHEMATIC ILLUSTRATION OF PATHWAYS OF FLOW OF ENERGY AND MATTER THROUGH A TERRESTRIAL ECOSYSTEM.

SOURCE: Van Dyne, G.M. 1969. "Some Mathematical Models of Grassland Ecosystems," P. 6, in R.L.Dix and R.G.Beidleman (ed.), "The Grassland Ecosystem : A Preliminary Synthesis." Range Science Department Science Series No. 2, Colorado State University, Fort Collins, Colorado.

Under natural conditions, nutrient cycles are more or less in balance. Agricultural activities remove nutrients in the form of crops, and grazing removes nutrients in the form of animals, disturbing the natural balance.

Many different nutrient cycles occur--little is known about many of them. However, the more perfect cycles have so many compensating mechanisms that apparently man has not significantly modified them. Disturbance or manipulation of a cycle involving a vital element, however, could disturb it beyond its compensatory powers and cause its complete collapse (2).

Energy Flows

Energy flows through the ecosystem, it does not cycle (3). The pathways of energy flowing through a terrestrial ecosystem are shown in Figure II-2. Energy from the sun is used by plants, and through the process of photosynthesis they convert solar radiation into plant material. Herbivores, carnivores, and omnivores, in turn, feed on plants and other animals to acquire energy. Bacteria, fungi, and some animals derive energy as they decompose dead organisms. Energy is continuously being consumed by the organisms, and new energy is continuously being acquired from solar radiation.

Hydrologic Cycle

The movement of water into, through, and eventually out of an ecosytem is a major stimulus in the functioning of the system. The cycling of water consists of precipitation inputs, runoff outputs, and a series of intermediate processes influencing the precipitation/runoff relationship. The intermediate processes include interception, infiltration, percolation, evapotranspiration, surface runoff, and storage. The hydrologic cycle is shown in Figure II-3 (35,36).

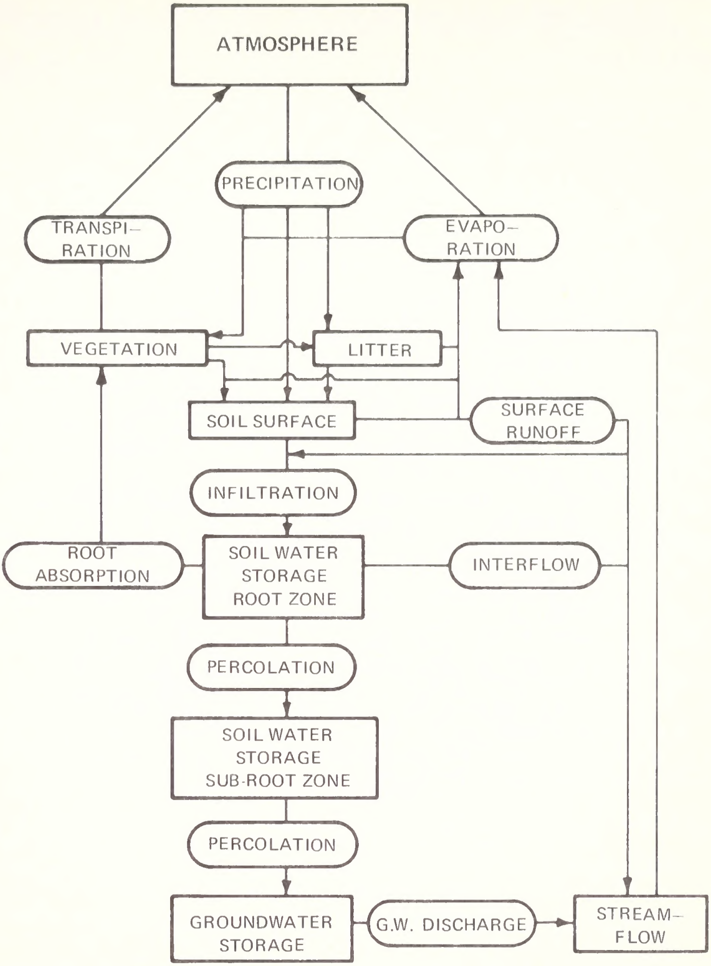

FIGURE II- 3 FLOW DIAGRAM OF THE GRASSLAND HYDROLOGIC CYCLE

SOURCE: Striffler, W.D. 1969. "The Grassland Hydrologic Cycle," P. 103, in R.L.Dix and R.G. Beidleman (ed.), "The Grassland Ecosystem : A Preliminary Synthesis." Range Science Department Science Series No. 2, Colorado State University, Fort Collins, Colorado.

Surface runoff and erosion affect land forms and stream characteristics such as suspended sediment and can significantly affect the ecological interrelationships. The activities of man can change surface runoff if soil and vegetation are disturbed and the disturbance is not corrected. Changes in surface runoff, in turn, influence the stream system's fluvial cycle--the manner in which running water changes land forms and stream patterns in a region over time. A fluvial cycle is determined, to a considerable extend, by climate and rock type. In general, drainage patterns evolve from an initial stage of gully development where runoff is concentrated, through several stages of land form modification to a surface of low relief.

Man's activities, if unchecked, can affect the fluvial cycle by allowing headcutting to accelerate or by allowing gullies to develop in a previously undisturbed area.

Unique Ecological Areas and Historical Sites

All biomes contain unique ecological and historical sites.[3/] Many are located on NRL. Unique ecological areas may include habitats of

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[3/] The Registered National Landmarks Program, administered by the National Park Service, U. S. Department of the Interior, is an inventory and registry of nationally significant natural and environmental education properties in the United States. Landmarks may be designated both on public and private lands. Landmark designation does not affect ownership or the responsibility of the owner for the property. Designated landmarks are listed in National Parks and Landmarks, available from the U. S. Government Printing Office. On January 1, 1972, there were 936 historic landmarks, 167 natural landmarks, and 11 environmental education landmarks in the registry. The National Register of Historic Places should be consulted to determine if historical properties are affected by proposed actions.

vanishing or rare species of plants or animals, and areas supporting a complete biotic community in a relatively undisturbed state. Examples include national monuments, parks, wildlife refuges, and unique or research natural areas.

Social Interrelationships

The human aspects and land use characteristics must be adequately considered in assessing potential impacts of any proposed action. Each biome has identifiable socio-economic influences and land use patterns which are considered in general terms for each biome. An overall social dimenson of ranch-community relationship is developed in a study [4] identifying the relevant component parts of a "ranch ethic". Four factor groups are categorized: (1) ranch fundamentalism, (2) conspicuous consumption, (3) economic goals, and (4) ties to local area and community.

The findings suggest a value in ranch ownership which is quite separately identifiable from productive returns of ranch operation. Several hypotheses can be drawn from the study results. The authors suggest a possibility that, because of the large percentage of ranch owners depending on part-time employment in local communities, it is the community which supports the ranching industry rather than vice versa. On the other hand, all regions in the West outside of the Pacific coastal areas are estimated to be net exporters of livestock products, thus providing a regional and and rural growth base. It may be that, in fact, the community does support certain individuals, allowing them to receive social benefits not normally measured in economic terms, yet the livestock industry as a whole provides a base which helps sustain (or slows the decline) of rural communities. Alternative land uses to grazing might provide an even stronger economic base, but in the process destroy the foundation of other social benefits.

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[4] Implications of Socioeconomic Goals and Attitudes of Cattle Ranchers on Rural Community Development in the West; by A. H. Smith and W. A. Martin; Arizona Agricultural Experiment Station Journal Paper 19.

Description of Individual Biomes

Grassland Biome

The grassland biome is the most extensive and varied of the biomes. This biome consists of five subregions, four of which are shown on Figure II-4. The subregions are:

The northern temperate grassland extends from the eastern forest across the Mississippi Valley to the foothills of the Rockies and includes the Great Plains.

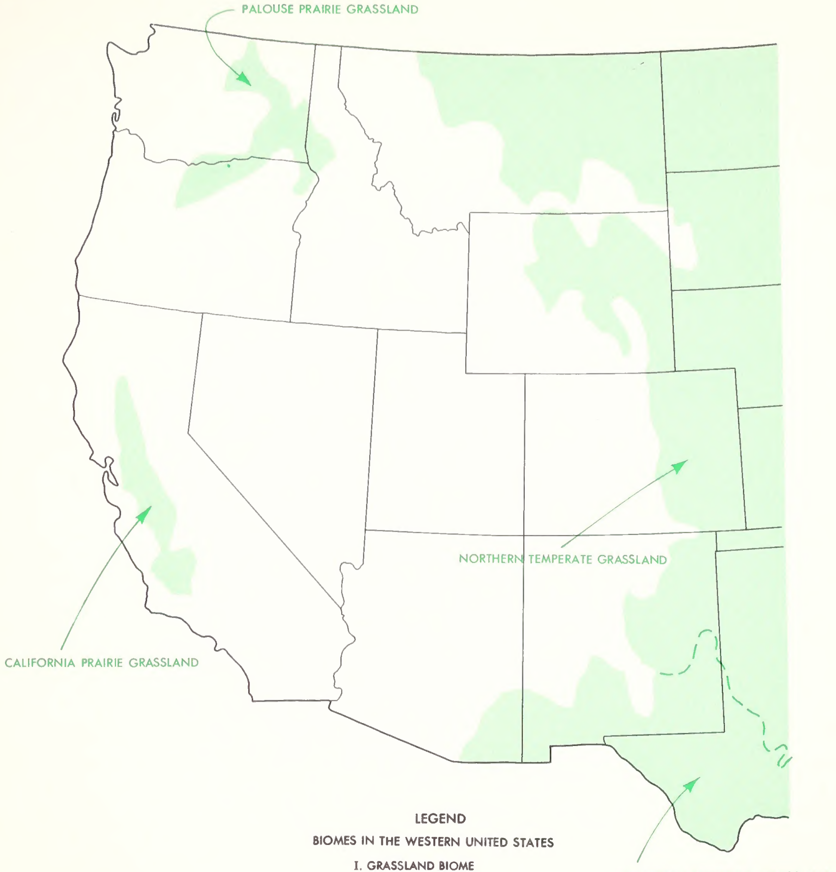
The southern temperate grassland includes southwest Texas and southern New Mexico.

The Palouse prairie includes small portions of eastern Washington, northern Idaho, and northeastern Oregon.

The California prairie includes the Central Valley of California.

The Coastal prairie includes the area along the Gulf of Mexico in south Texas and parts of southern Louisiana, but will not be discussed, as it contains no significant amount of NRL.

The general aspect of the four subregions to be discussed is shown in Figures II-5 through II-8.


PALOUSE PRAIRIE GRASSLAND
NORTHERN TEMPERATE GRASSLAND
CALIFORNIA PRAIRIE GRASSLAND
SOUTHERN TEMPERATE GRASSLAND

LEGEND

BIOMES IN THE WESTERN UNITED STATES

I. GRASSLAND BIOME
  1 Temperate Grassland 🟩
  2 Palouse Prairie Grassland 🟩
  3 California Prairie Grassland 🟩
II. DESERT BIOME
  1 Cold Desert
  2 Hot Desert
III. WOODLAND-BUSHLAND BIOME
  1 Broad Sclerophyll
  2 Oak Woodland-Bushland*
  3 Juniper Associates*
IV CONIFEROUS BIOME
  1 Northwest Coastal Forest
  2 Montane Forest

(*Generally included within the desert biome boundary.)

FIGURE II-4 THE GRASSLAND BIOMES IN THE WESTERN UNITED STATES.

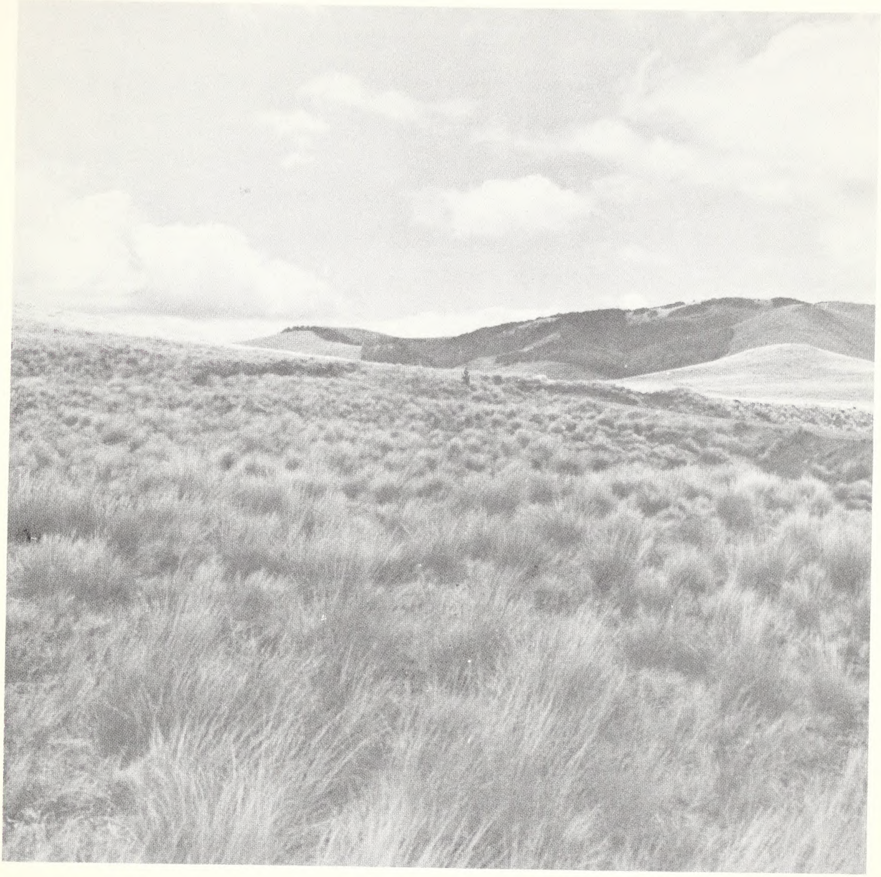


Figure II-5. The northern temperate grassland

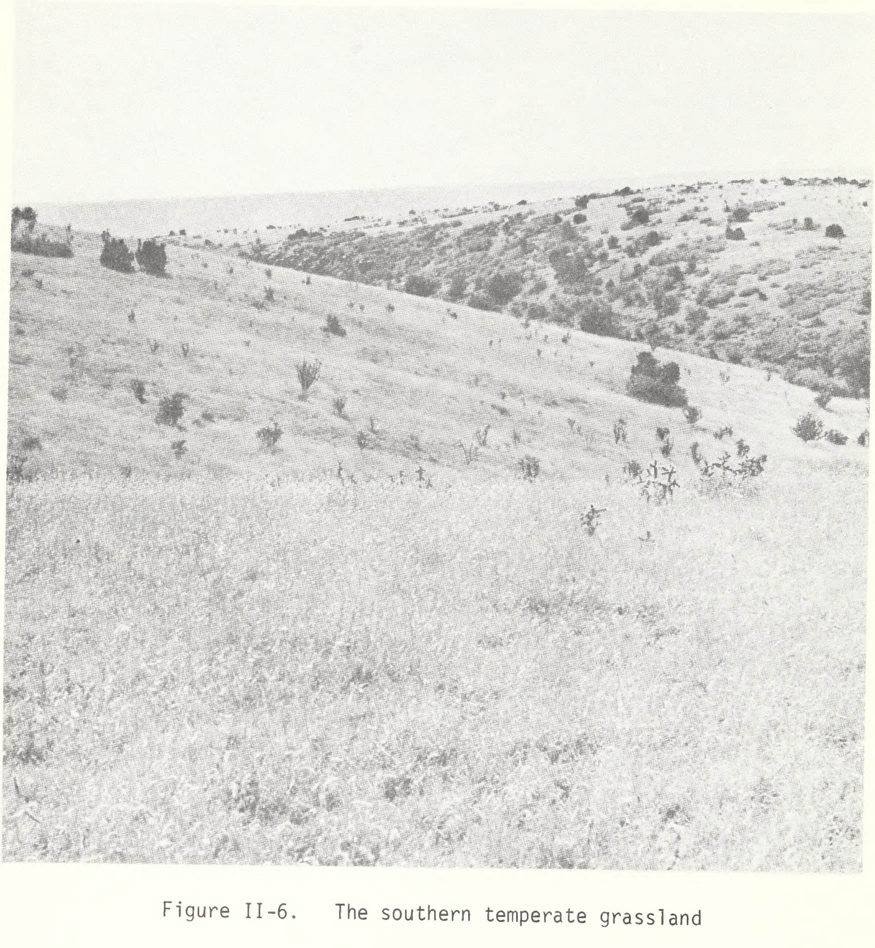


Figure II-6. The southern temperate grassland

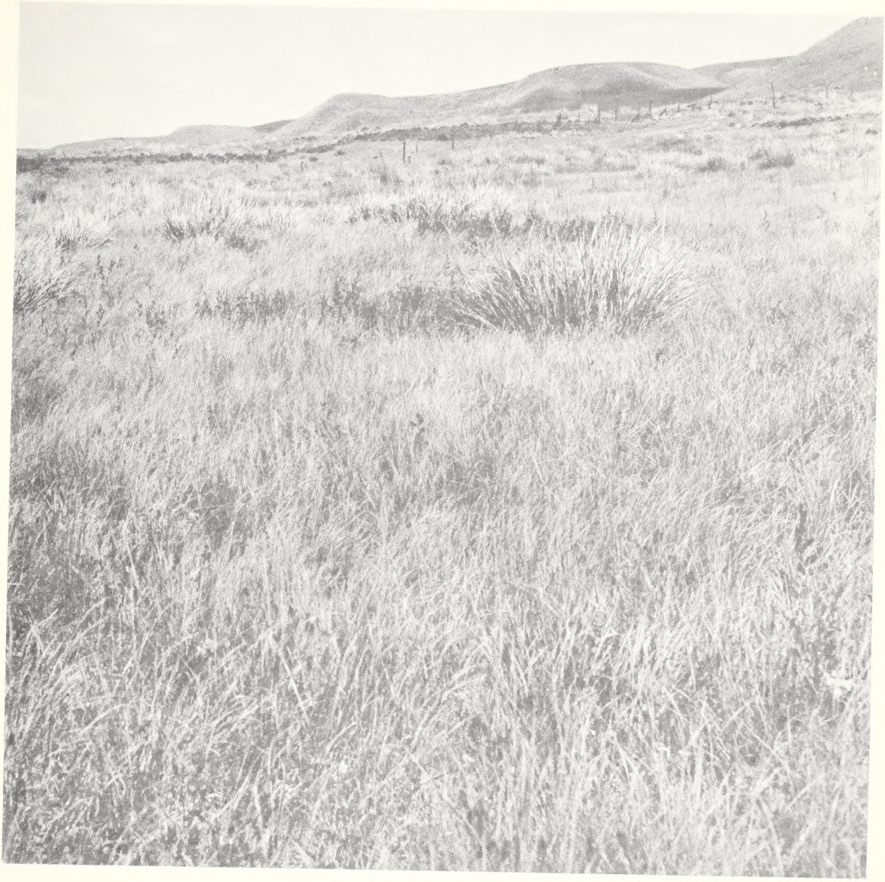


Figure II-7. The Palouse prairie

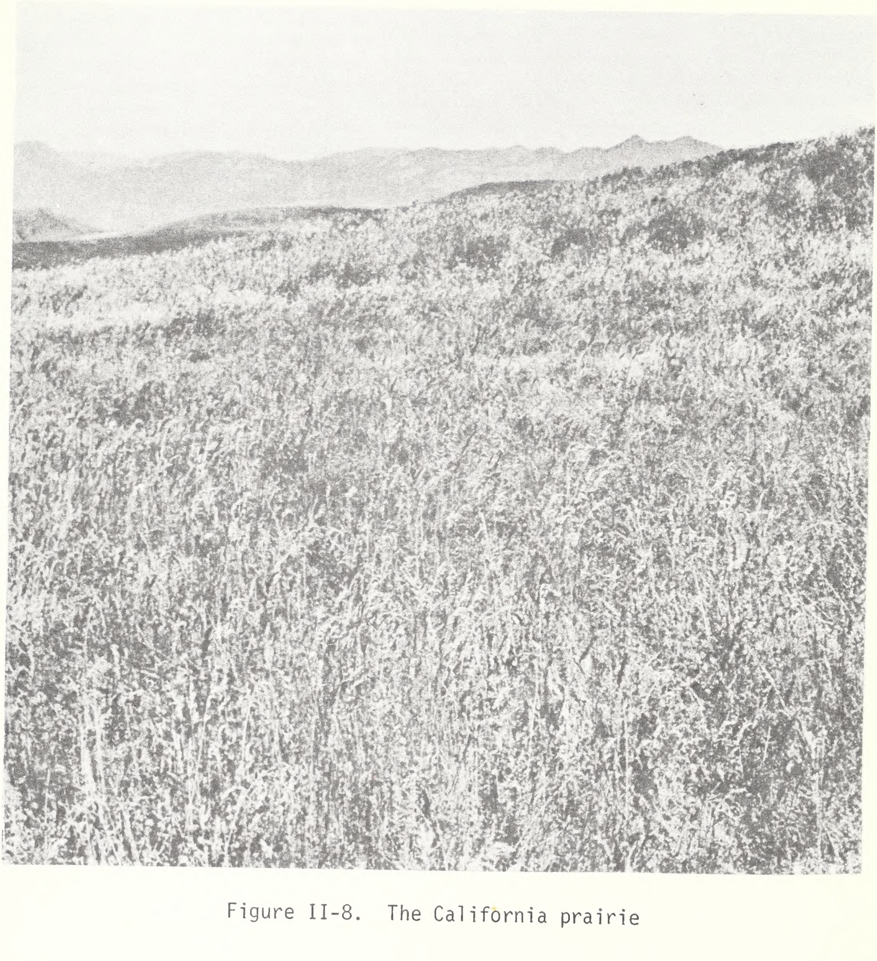


Figure II-8. The California prairie

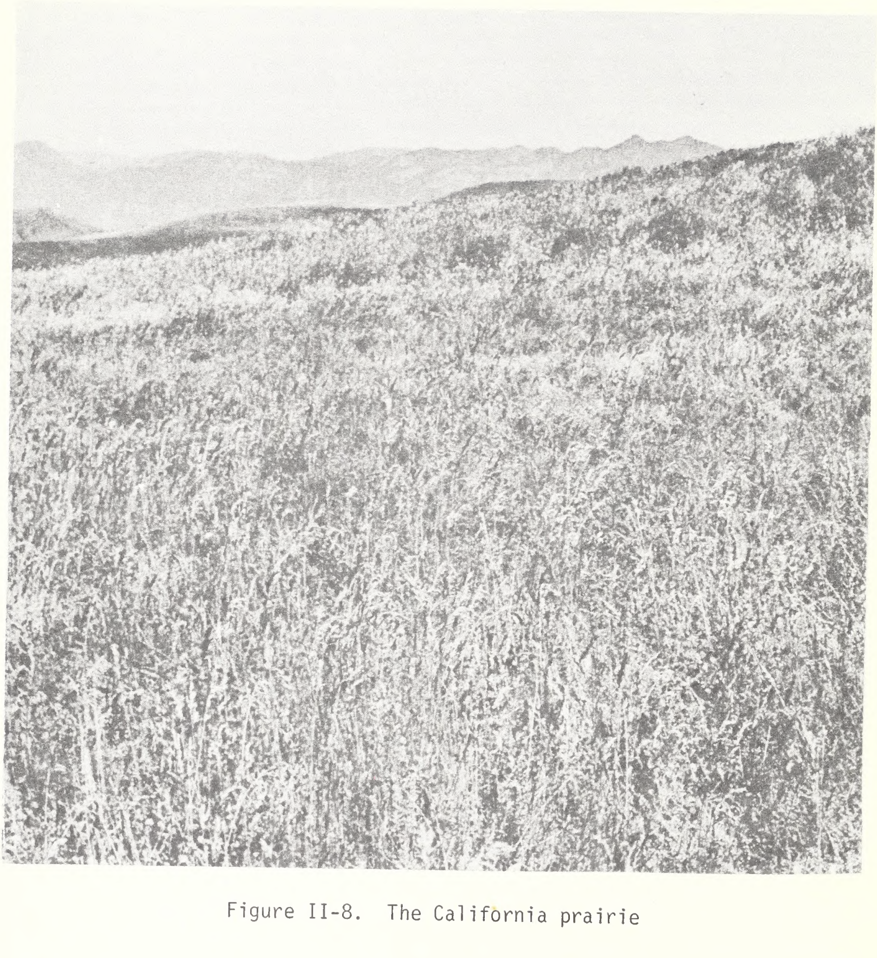
Nonliving Components

Topography

The topography of the northern temperate and southern temperate grasslands is predominantly rolling hills and plains. The land in the northern and southern temperate grasslands generally slopes gently from west to east, with altitudes ranging from 4,000 to 5,000 feet along the western boundary and 400 to 500 feet along the eastern boundary. There are several isolated mountain groups in the western edge of the region--the Black Hills in South Dakota and the Bearpaw, Little Rocky, and Big Snowy Mountains in Central Montana. Other significant topographic features include the Sand Hill Region in central Nebraska, western Oklahoma and southwestern New Mexico; the Badlands of west-central South Dakota; and the glaciated regions of northern Montana and North Dakota.

Most of the northern and southern temperate grassland drainage flows directly to the east, controlled for the most part by the original surface of the east-dipping sediments. Three principal plains levels and at least one remnant upland level dominate the landscape between the eastern and western boundaries of the grasslands. These form a set of steps ascending to the west.

The Palouse prairie lies east of the Cascade Mountains and includes all of the North-Central Plateau, and Blue and Wallowa Mountains, the Owyhee Upland, the High Lava Plains, and the Basin and Range province. Topography varies from open hills and mountains to irregular plains and moderate to high-relief tablelands.



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Soils [4]

The soils of the northern and southern temperate grasslands vary considerably from north to south and from west to east. Only the soils in the western portion of the grasslands are described below.

Along the Canadian border in Montana and North Dakota, the soils are the cool-moist, organic-rich Mollisols. In southern Montana, southwestern North Dakota, and northwestern South Dakota, soils are the warm-dry Entisols. In northeastern Wyoming, the mature warm-dry Aridisols predominate; in southwestern Wyoming and northeastern Colorado, the warm-dry organic-rich Mollisols are dominant. Southeastern Colorado has the warm-dry, immature Entisols, or soils that are still forming, and the warm-dry, mature Aridisols that are well-formed with natural horizons. Eastern New Mexico has four warm-dry soils: the immature Entisols, the organic-rich Mollisols, the brown-to-grey base Alfisols, and the mature Aridisols.

The soils of the California prairie above the stream valleys are warm-dry Alfisols while those along the rivers and streams are warm-dry Entisols.

Palouse prairie soils are predominantly warm-dry Mollisols. At the junction of the Columbia and Snake Rivers, the soils are Entisols; farther up the Columbia, a small area of Aridisols has developed.

Minerals.

A large portion of the oil and gas production of the United States is derived from this biome. Oil and gas exploration is very active with most of this activity confined presently to areas east of the Rocky

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[4] Soil stability classes, the soil orders and series, and major soil characteristics are described in Appendix II-B, C, and D.

Mountains. Commonly connected with the mineral activities are roads, pipelines, drilling sites and small surface plants.

Large, shallow deposits of coal occur in Montana, Wyoming, New Mexico and Oklahoma. Surface mining is causing considerable ground disturbance in several locations. Most of the coal is shipped outside the biome for consumption in steam plants to produce electric power. The coal in this region is relatively free of sulfur emissions when burned.

Water (37)

The major surface waters in the grassland biome are the through-flowing rivers and streams of major drainage basins--the Missouri, western Upper Mississippi, middle Arkansas, White, Red, lower Rio Grande, Texas-Gulf, middle Columbia-North Pacific, and the California Central Valley. The large rivers, the Missouri, Yellowstone, Platte, Arkansas, Rio Grande, Columbia, and Sacramento, receive most of their inflow from the higher elevations above the grasslands. Many of the smaller streams within the more arid grasslands flow intermittently.

Annual runoff in the grassland biome ranges from less than one inch to more than five inches of water in much of the northern temperate grassland.

The total dissolved solids in surface water in the grasslands range from less than 100 parts per million (ppm) to more than 1,800 ppm. The amount of dissolved solids in a watercourse are affected by the type of soil and parent material in the region, the length of time the water has been in the watercourse, and the extent to which the flows are diluted by water from other sources. The specific chemical composition is an important consideration in determining whether water can be used for specific purposes. The total amount of dissolved solids in the water generally is the controlling factor in determining if a water supply is chemically suitable for most general uses.

The average suspended-sediment concentrations in streams in the grassland biome range from less than 230 ppm to more than 30,000 ppm. The suspended-sediment in a stream comprises such particulates as sand and silt. Suspended-sediment tends to be greater in areas where soil is not held in place by a dense vegetative cover.

The quality of water in most rivers, streams, lakes, and springs in the biome is adequate for most plant, animal, and human uses, however, localized pollution of water does occur.

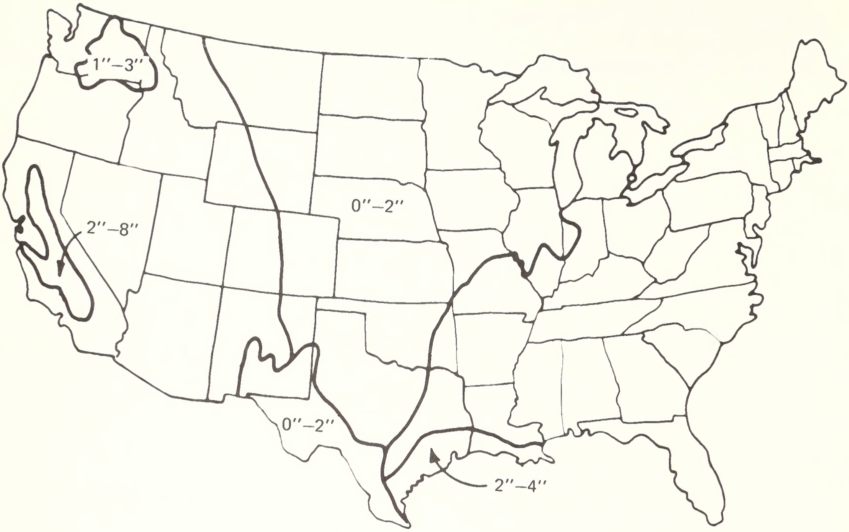
Climate (3,37,38,39,40)

The northern temperate grassland has a continental climate. The average annual precipitation varies from 15 inches in the northwestern section to 30 inches in the southeastern portion. Seasonal precipitation varies from year to year. As shown in Figure II-9, most precipitation occurs as rainfall from summer thunderstorms. Temperatures range from 40 degrees F below zero to 110 degrees F above. Mean daily temperatures vary from 0 degrees F in January to 70 degrees F in July in the northern section, and from 50 degrees F in January to 80 degrees F in July in the southern portion (Figure II-10). Winds are generally from the northwest in the winter months; they average 10 mph, but range up to 40 mph or more and bring dry, cold air (Figure II-11). In the summer months, dense fog occurs about five to 10 days each year (Figure II-12). Humidity generally is low in the western portion and increases to the east.

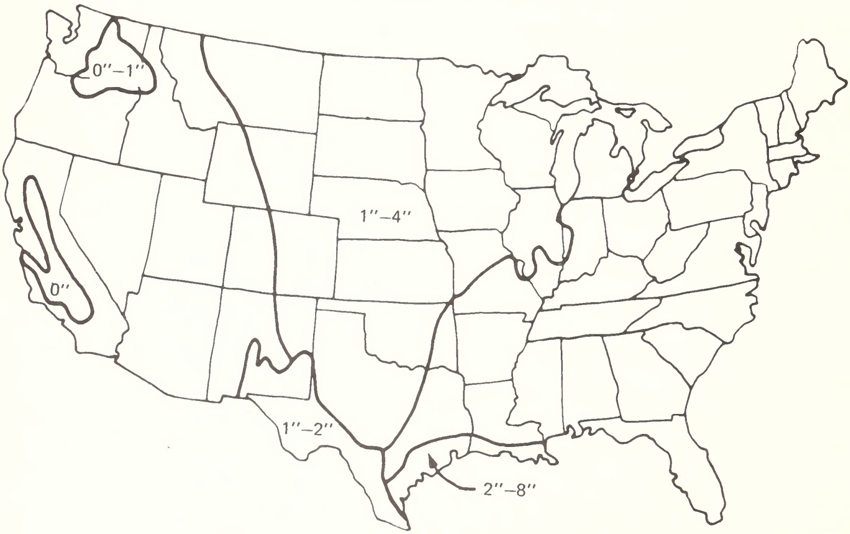
The southern temperate grassland's climate is influenced by the continental air mass to the north and the humid Gulf to the southeast. The average annual precipitation varies from 10 inches in the northwest to 40 inches in the southeast portion of the biome. Figure II-9 shows that most precipitation occurs during the summer months. Temperatures range from 10 degrees F below zero to 110 degrees F above; mean daily temperatures vary from 35 degrees F in January to 75 degrees F in July in the southeast. Winds generally are variable and light in the winter months; during the summer, they tend to blow from the southeast (Figure II-11), bringing moist warm air from the Gulf.

The Palouse prairie's climate generally is influenced by the continental air mass, with some modification from the Pacific Ocean. Consequently, the area has a milder climate than the north temperate grasslands to the east. Average annual precipitation ranges from 10 to 15 inches. Most precipitation falls in the winter months (Figure II-9). Thunderstorms occur about 10 days out of the year. Temperatures reach extremes of 30 degrees F below zero to 110 degrees F above; the mean daily temperature (Figure II-10) varies from 25 degrees F to 30 degrees F in January to 70 degrees F in July. Winds generally are from the south in both winter and summer (Figure II-11). They average eight mph, but may gust strongly at times. Dust storms may occur in the summer months when the light surface soil is dry. Dense fog occurs about 10 to 20 days each year; maximum frequency is in October (Figure II-12).

The California prairie's climate is influenced by the Pacific Ocean. The average annual precipitation varies from six inches in the south to

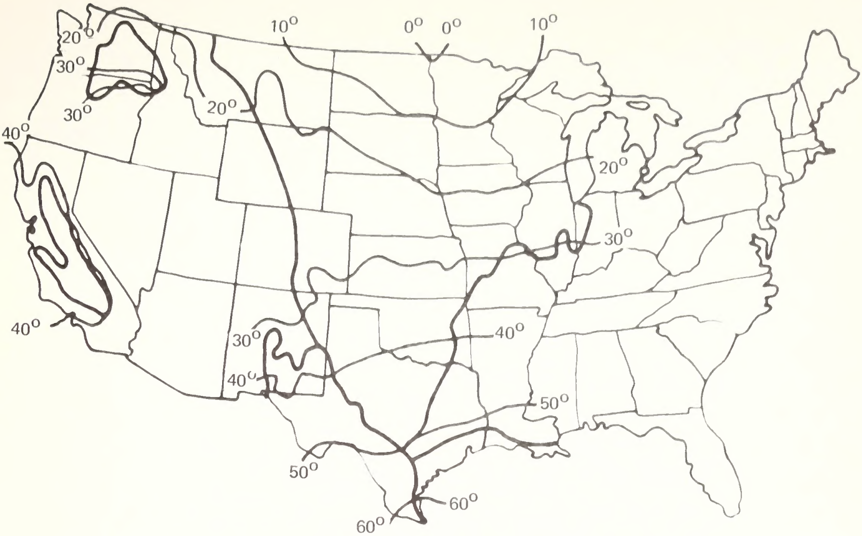


MONTHLY PRECIPITATION (INCHES)–JANUARY

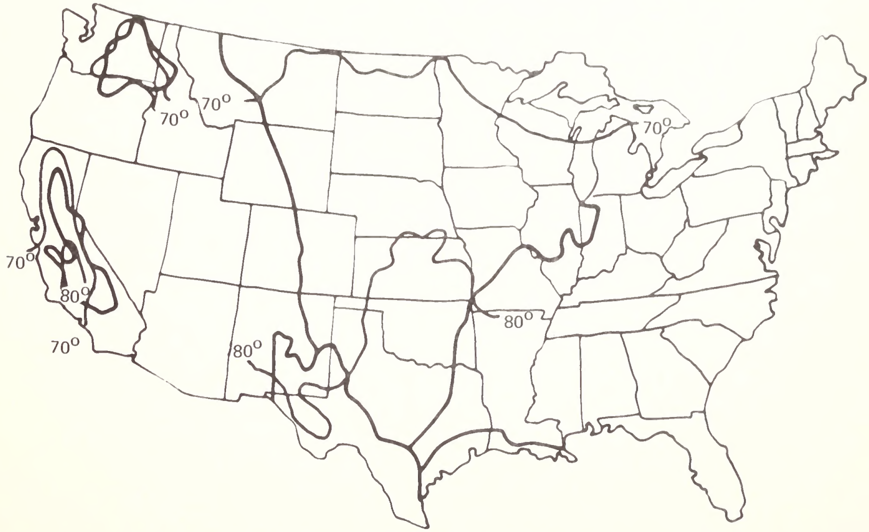


MONTHLY PRECIPITATION (INCHES)–JULY

Figure II-9 Average January and July precipitation in the grassland biome



AVERAGE DAILY TEMPERATURES (°F)—JANUARY



AVERAGE DAILY TEMPERATURES (°F)—JULY

Figure II-10. Average daily temperatures in the grassland biome in January and July

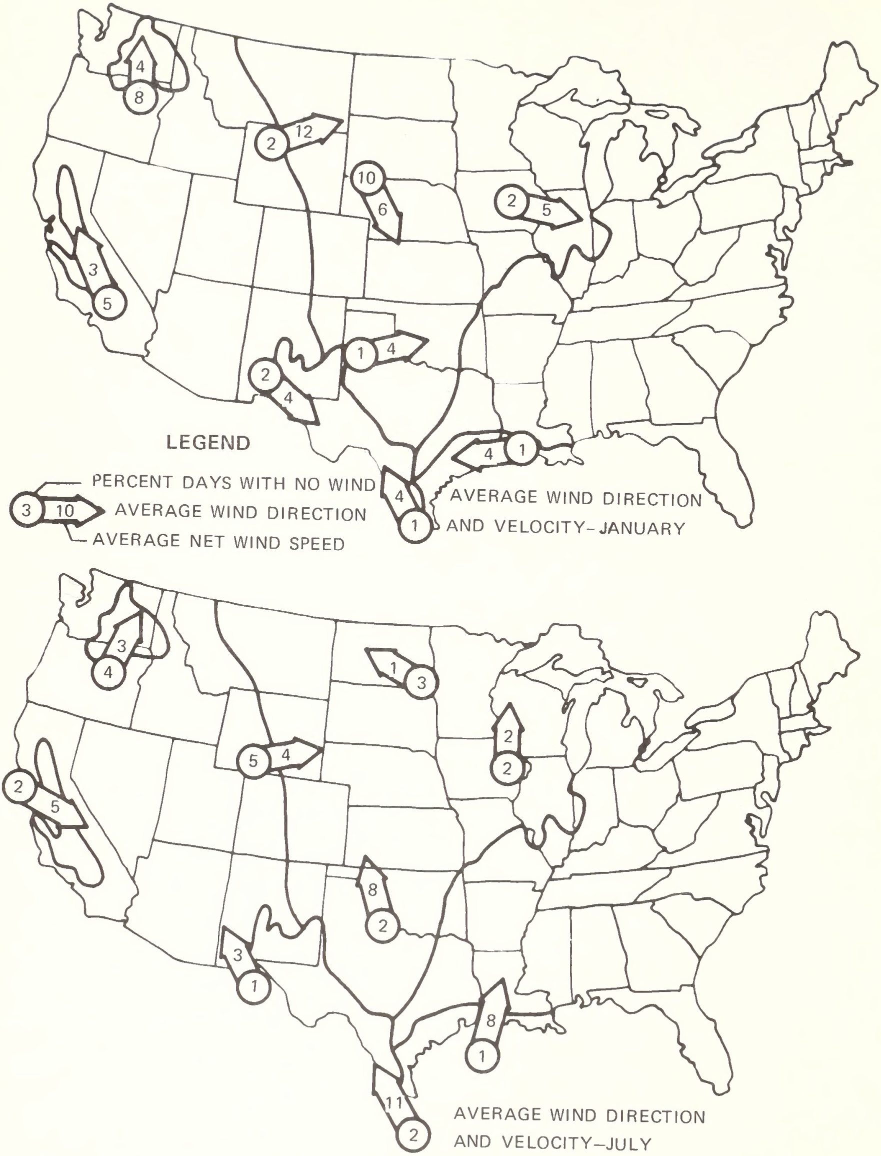
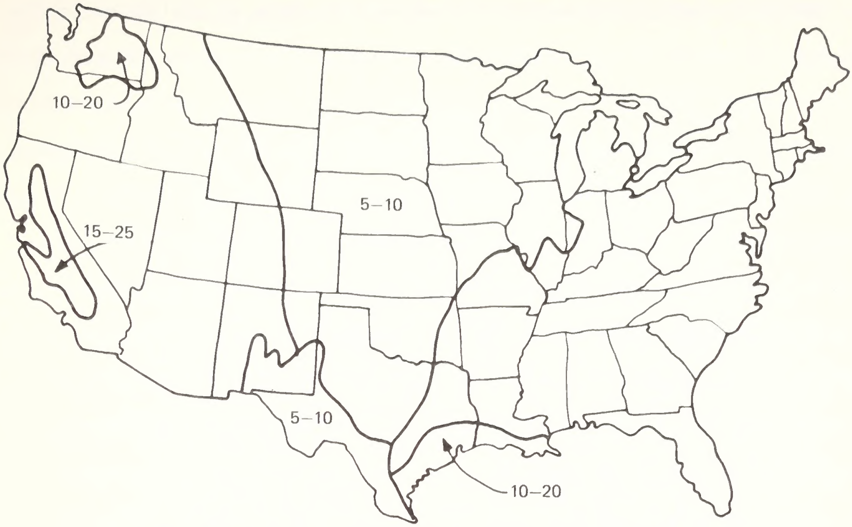
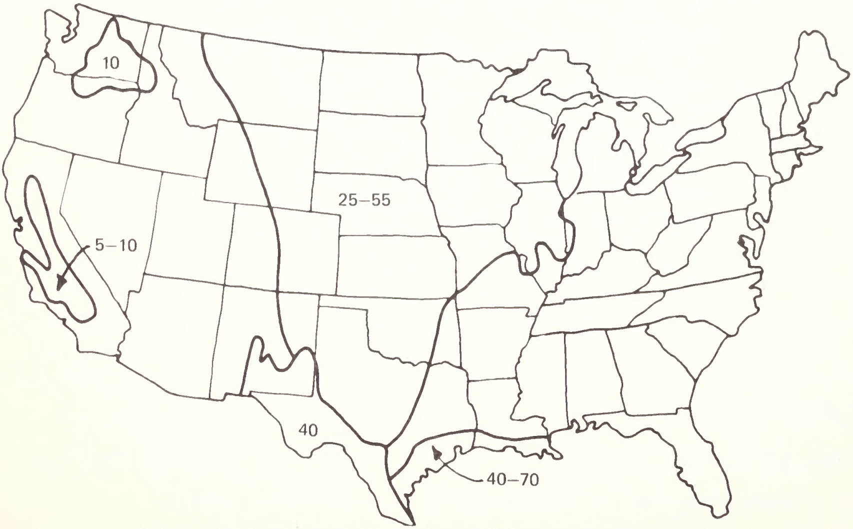


Figure II-11. Average wind direction and velocity in the grassland biome in January and July



AVERAGE NUMBER OF DAYS ANNUALLY WITH DENSE FOG



AVERAGE NUMBER OF DAYS ANNUALLY WITH THUNDERSTORMS

Figure II-12. Average annual number of days with fog and days with thunderstorms in the grassland biome.

23 inches in the central part of the grassland. Most precipitation occurs during the winter months; almost none falls during the summer (Figure II-9). Thunderstorms occur during the winter months with the passage of cold fronts. Temperatures range from 15 degrees F to 115 degrees F. Mean daily temperatures vary from 40 degrees F in January to 80 degrees F in July (Figure II-10). Winters are mild and summers are hot. Winds generally are from the south during the winter months (Figure II-11). When storms move through the area, winds tend to blow from the northwest. During the summer months, the wind is generally out of the west. Dense fog occurs from 10 to 25 days during the winter as temperature inversions keep moist Pacific air trapped within the valley basin.

Living Components

Vegetation

The predominant vegetation of the grassland biome is a variety of grass species occurring in both a natural state and in extensive cultivated areas. The vegetation is typified by unbroken expanses of prairie. Many of the native and introduced grass species are used for agricultural crops or forage for domestic and wild animals. Several species of woody plants grow in the biome; some, such as the sagebrushes and sageworts, provide important forage for herbivores in the winter and cover for many forms of wildlife on a year-round basis. Grazing of domestic animals has been one of the major contributors to plant succession, particularly in increasing the distribution of woody plants and forbs. In addition to serving as an important food source, the grasses stabilize soils, minimizing water and wind erosion.

In general, the grasslands are located where rainfall is insufficient to support forest-like vegetation, but is sufficient to preclude the formation of a desert.

Marshes, lakes, ponds, and streams support various forms of aquatic vegetation. Algae are the most important producers in the fresh-water environment. Except for pond and duck weeds, most higher aquatic plants are members of diverse families in which the majority of species are terrestrial.

The northern temperate grassland includes three broad perennial grass zones extending north and south across the western Mississippi Valley. The tall grass prairie is located on the eastern edge of the grasslands; the mixed grass prairie is intermediate; and the short grass prairie extends along the western edge.

The southern temperate grassland most resembles the short grass zone of the northern temperate grassland. It is the driest area in the grassland biome. Parts of it are dotted with desert shrubs because of the dry climate and overgrazing.

The Palouse prairie consists of mid-grass species. However, extensive areas have been replaced by sagebrush. Large wheat crops are produced in portions of the region.

The California prairie originally consisted of mid-grasses of the bunch grass type similar in form to those of the Palouse. Many of the native grass stands have been replaced by annual grasses introduced from Europe. Parts of the tule marshes along the major drainages have been converted to rice production.

Animals

The high annual turnover of net primary production in most grassland communities provides a foodbase for a large number and variety of animals. Many species are grazers, others are burrowers, and a large number of birds are ground nesters. Large herbivores, such as deer and antelope, are a characteristic and sometimes common feature. Insect life is abundant, varied, and heavily utilized as food by many secondary consumers. Every major animal phylum and many taxonomic groups of the plant kingdom are represented in the biome. Many of the animals are gregarious and frequently occur in large concentrations.

Droughts periodically occur in grassland communities, and the populations of some wild animal species can fluctuate widely from year to year.

Large domestic herbivores, such as horses, cattle, sheep, and goats, have largely replaced, or live in competition with, the native herbivores. Grazing significantly influences grassland ecosystems throughout the United States.

Terrestrial Wildlife (41)

The most conspicuous terrestrial wildlife are mammals and birds. In the northern temperate grassland, characteristic animals include antelope, mule and white-tailed deer, white-tailed jackrabbits in the north and black-tailed jackrabbits in the south, prairie dogs, ground squirrels, coyotes, badgers, ferrets, pocket gophers; various waterfowl, prairie chickens, sage grouse, Swainson's hawks, rough-legged and ferruginous hawks, burrowing owls, ground-nesting birds such as the meadowlark and horned lark; bullsnakes, rattlesnakes, and an abundance of insects.

The southern temperate grassland includes many of the same animals found in the north, although some are a different species or subspecies. Other forms more common in the south include the antelope jackrabbit, desert cottontail, collared peccary, scaled quail, white-winged dove, scissor-tailed flycatcher, mockingbird, kingsnake, and several kinds of lizards.

In the Palouse prairie, the sharptail grouse was abundant in the past. The short-eared owl, burrowing owl, and marsh hawk nest in the grassland. The cottontail and pygmy rabbit, pocket gopher, golden-mantled ground squirrel, and various grasshoppers are characteristic fauna.

In the California prairie, the California ground squirrel is one of the most characteristic species. The area is important wintering habitat for waterfowl. Many of the same animals, perhaps of different subspecies, occur here as in other grassland areas.

Many grassland species warrant special consideration because of their particular needs. For example, a local population may require a specific site at a particular season to continue its life cycle, such as strutting grounds for sharptail grouse, sage grouse, or prairie chickens; and waterfowl and shorebird nesting areas around potholes, reservoirs, and marshes. 5/

Some species extend their distribution into vegetal subtypes, and the local animal populations become totally dependent upon the restricted habitat. An example is the moose in the wooded drainages of the northern temperate grasslands in eastern Wyoming. Some species, while not endangered throughout their range, have remnant populations in danger of being

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5/ The water bodies in the northern temperate grasslands of the United States and Canada produce most of the waterfowl in North America.

eliminated in local areas. The sharptail grouse in the Palouse prairie is an example. Local populations of some species are restricted to relatively small sites, such as prairie dog towns. Other species, such as the endangered black-footed ferret, are dependent upon the prairie dog as a primary food source and utilize the prairie dog burrows for homes.

Aquatic Wildlife (41)

Aquatic wildlife includes fish and various invertebrates confined to a water environment such as shellfish. Aquatic fauna in the grassland area are less diversified than in the more humid regions. The natural distribution of nonmigratory fish is confined to water bodies with accessible and suitable spawning areas.

Anadromous fish species (examples - salmon, steel head) utilize the river systems which pass through the Palouse prairie and California Prairie grasslands for spawning purposes.

Warm water fish species occur in larger streams and warm standing waters. Examples include the shovelnose and lake sturgeons, paddlefish, and gars of the Missouri River. Channel catfish inhabit small tributaries of the Missouri and some large reservoirs with warm, muddy waters. Bullheads are adapted to a wide range of conditions, but prefer warm streams or ponds. The black bass, blue gill, and perch occupy a wide range in relatively cool streams, lakes, and reservoirs. Cold water species in the high elevation, clear, spring-fed streams include various trout, mountain whitefish, grayling, suckers, and sculkins.

Threatened Wildlife (42)

Several threatened species of wildlife are characteristic of the grassland biome. These include: Tule elk, San Joaquin kit fox, black-footed ferret, prairie falcon, American peregrine falcon, northern greater and lesser prairie chickens, Mexican duck, and the blunt-nosed leopard lizard.

Threatened fish species are found within the biome. Currently identified species include the Pecos gambusia, greenback cutthroat trout, Rio Grande cutthroat trout, and the Arctic grayling.

Domestic Livestock (43)

During the period of early settlement by Europeans, the grasslands were used almost exclusively for livestock grazing. Today, beef, lamb, and wool still are the principal products of areas that have not been converted to crop production.

More cattle than sheep and goats are grazed on the grasslands because cattle are better adapted to the type of forage produced in most of the biome. Goats are limited, for the most part, to the brushier areas of the south temperate grassland. Sheep production is a significant land use in areas where shrub species are a prominent component of the vegetation.

Cattle numbers have steadily increased over the years, and sheep numbers have sharply declined. After a period of rapid decline, horse populations have remained fairly stable in recent years.

Wild Horses and Burros 6/

Wild free-roaming horses and burros on national resource lands are protected by PL 92-195. BLM is responsible for the management and protection of these animals.

The population of wild horses and burros on NRL in the grassland biome is not significant when compared to the desert and woodland-bushland biomes.

6/ Environmental Impact Statement - Proposed Wild Free-Roaming Horse and Burro Management Regulations. U. S. Department of the Interior, Bureau of Land Management, Washington D. C. 1973

In Montana, there are an estimated 264 wild horses with around 150 head in the Pryor Mountain area, part of which has been designated as the Pryor Mountain Wild Horse Range. There are no known wild burros in Montana. A few wild horses and burros have been reported in the grassland biome of New Mexico.

Generally, it is recognized that burros and horses compete for both food and water with wildlife and domestic stock.

Soil Organisms

The function of soil fauna in grassland ecosystems is presented by Paris in a paper on the grassland ecosystem (44). The following information was taken from this paper:

Taxonomic Group	Food	Community Function
Earthworms	Litter, mineral soil	Primary decomposition, comminution of litter, mixing of soil and litter, producing crumb structure in soil.
Mollusks	Green and dead forbs, fungi	Primary decomposition herbivory.
Isopods	Litter	Comminution of litter, some herbivory.
Diplopods	Litter	Primary decomposition, comminution of litter.
Dipterans	Litter, carrion	Comminution of litter, primary decomposition of carrion.
Coleopterans	Dung, carrion	Primary decomposition of dung and carrion.

Taxonomic Group	Food	Community Function
Nematodes	Protoplasm of fungi, bacteria, roots, and small animals	High rate of energy dissipation, nitrogen turnover, influence on microbial populations uncertain.
Enchytraeids	Fungi, bacteria	Not well known, but important in energy flow and probably nutrient cycling.
Collembolans	Fungi, bacteria, algae, fluids of plants and small animals.	Comminution of plant remains, dispersal of fungal spores, effects on microbial populations uncertain.
Mites	Fungi, bacteria, algae, small animals	Dispersal of fungal spores, influence on fungal populations uncertain, communition of litter.
Ants	Omnivorous	Probably important in energy flow, may influence aphid populations by predation, seed consumption, mounds and tunnels affect soil structure.

Paris concludes that decomposing reducers are essential for maintaining an equilibrium state in the energy flow and nutrient cycle of grassland ecosystems. Even in the shortgrass prairies of North America where several of these groups are absent or rare, soil insects (dung beetles, fly larvae, and ants) are probably important in ecosystem dynamics. Were these organisms to disappear from a grassland, not only would their direct contribution to energy flow and nutrient cycling be eliminated, but the rate of microbial decomposition would decrease.

The soil microorganisms are an important part of the grassland ecosystem. It has been estimated that for a bluegrass community, decomposers use 70 percent of the net production (45). Another study estimated that for the total energy trapped by photosynthesis, less than 14 percent was respired by higher plants, 28 percent was consumed by herbivores and 56 percent was released during the decomposition of plant materials (46). Additional data on the role of soil organisms may be found in a paper by Clark in the IBP grassland publication (47).

Human

Demographic characteristics of the grassland biome vary considerably from one area to another. Most lands in the biome are rural. However, the biome also includes several large urban centers with significant differences in population densities, economies, and social environments. Nearly 17 percent of the total western states' population lives in this biome.

Most of the counties in the biome are sparsely populated; densities over much of the area in 1970 were less than 10 persons per square mile, compared with a national average of 57.3 persons per square mile and a western state average of 29 persons per square mile. Most of the areas having a low population during 1960-1970 lost people in the decade. Significant gains were experienced in most urban areas (48). The biome as a whole lost rural population at a greater rate than the five percent western states' average.

Income levels throughout the biome are generally lower than average for the West. For example, per capita income in the plains of New Mexico is only about 70 percent of the western states' average while the per capita income of the Colorado and Wyoming Plains is about 90 percent of the average. The percentage of families under the poverty level is also generally greater (except in Wyoming) than the western average.

Low population densities and other characteristics of the rural areas reflect economies geared to resource production and primary processing. Agriculture and agricultural processing are principal economic activities. The isolation of resources from major markets has limited industrial growth in much of the area. The recreation-tourism industry has grown rapidly over the past 20 years and provided employment in the services sector of the economy.

Employment in agriculture is four percent of the work force for the 11 western states as a whole. In the grassland biome, the percentages range from four percent in Colorado to 26 percent in northeastern Montana. However, livestock production makes up varying proportions of the agricultural sector. The percent of total income derived from livestock production is estimated to range from slightly over two percent in the Central Valley of California to nearly 12 percent in the Great Plains of Montana. Except for the California and perhaps Colorado portions of this biome, livestock production contributes relatively more to total incomes than in any other biome. The NRL supply 2,890,000 cattle AUMs and 500,000 sheep AUM's to the livestock industries of the biome. These AUMs account for eight percent of the total cattle and sheep feed consumed in the biome except for the southern grassland area of New Mexico, where it approaches 19 percent.

Small towns and villages are scattered throughout the rural areas of the biome. Towns with populations of five to 10 thousand are market centers and generally are located along major transportation routes. (See Appendix II-E for rural-urban trend.)

Urbanized areas located in the western portion of the biome in close proximity to extensive federal lands include Great Falls and Billings, Montana; Boulder, Denver, Colorado Springs, and Pueblo, Colorado; Spokane, Washington; and the extensive Central Valley metropolitan complex in California. Metropolitan populations of each of the areas exceeds 50,000. The Denver metropolitan area, for example, had a 1970 population of 1.25 million and a growth of 32 percent from 1960 to 1970 (48). If present trends continue, the prediction of an urban megalopolis stretching from Cheyenne, Wyoming to Pueblo, Colorado, may be realized by the end of the century.

The metropolitan areas have combinations of capital, labor, services, and demand for products that support industrial development. The population concentrations support educational and cultural opportunities and a variety of housing and personal services. Economic and social environments are markedly different from those of rural areas in the biome.

Ecological Interrelationships

The grassland ecosystem is probably the most studied of all ecosystems, and there is extensive literature available on many of the ecological components. However, the aquatic ecosystem and its relationship to the terrestrial community is less well known than the ecological relationships within the terrestrial community.

The grasslands generally occur in regions of limited moisture; droughts are common. Precipitation during the May-to-October growing season occurs largely as convectional thunderstorms or frontal storms. The output of the hydrologic system is low compared to other biomes. Variations among the communities within the biome--(such as short-grass and mixed-grass communities)--generally occur because of varying rainfall, insufficient soil storage capacity, or both. Winds and the high evapotranspiration rates also have an important effect on components of the ecosystem. Thus, water is a critical factor in the grassland ecosystem.

The grassland is a vast solar-powered ecosystem capable of producing great quantities of energy. Annual production is generally high, and the turnover of the biomass occurs rapidly on an annual basis. Only small amounts of nutrients are tied up in the biomass. Soil organisms are numerous. As much as half of the producer biomass is directly decomposed by fungi and bacteria rather than by herbivores.

Nitrogen and phosphorous are the most important nutrients provided by vegetation to support other life forms in the grassland biome. Unconsumed nutrients are recycled through the soil in a short time because of annual mortality or dieback of the grass. This contrasts with biomes such as the forest biome where the nutrient cycle is slower and where a large share of the nutrients are stored in trees having a natural life span of hundreds of years. However, the nitrogen fixation rate on predominantly grass-covered sites is very slow and could be a critical factor in determining the revegetation recovery period of some disturbed areas.

Except in locations of steep topography, low precipitation, and unstable soil, the grassland ecosystem generally is stable. Surface disturbance can be rehabilitated and natural successional development occurs rapidly. Even though it may take many years to restore the original vegetation and animal species of the ecosystem, lesser species invade rapidly into a disturbed area.

The grasslands are most vulnerable to damage early in the growing season and in periods of drought, which commonly occur.

Land Uses

The Homestead Act of 1862, railroad construction, irrigation, and other factors led to the cultivation of vast areas in the grassland biome. Most lands remaining in a natural condition are unsuited for cultivation. Some are privately owned, but many in the western grasslands are federally owned. The uncultivated lands are extensively used for livestock grazing and outdoor recreation. Hunting, fishing, hiking, and other outdoor recreation activities are particularly significant on lands remaining in federal ownership.

In the northern and southern temperate grasslands, the amount of agriculture and the percentage of private ownership decrease progressively from east to west. Cattle and wheat ranching predominates in the western section. A large portion remains undeveloped, providing significant recreation opportunities. Roadless sections with primitive qualities remain in some areas.

The California prairie contains productive irrigated agricultural land. Nuts, fruits, vegetables, rice, and specialty crops are grown in the area. Undeveloped areas are extensively used for livestock grazing and outdoor recreation. Outdoor recreation is a particularly significant use on some lands because of the proximity of large metropolitan areas.

Wheat grown by dry farming methods is the major agricultural use in the Palouse prairie. Significant areas in the western portion are irrigated; unirrigable portions remain undeveloped and are used for grazing.

Most metropolitan areas and some of the smaller cities in the biome are growing rapidly and using additional lands for residential, commercial, and industrial expansion. Inevitably, increased population concentrations place additional demands on adjacent rural and undeveloped lands for recreational uses.

The most extensive form of mineral extraction in the biome is concentrated in oil and gas production in portions of the northern and southern temperate grasslands and in the southern portion of the California prairie. A number of coal surface mines are located in the northern part of the temperate grasslands. Increasing demands for low-sulfur coal probably will lead to increased mining of the large coal deposits in Wyoming, Montana, Colorado, and North and South Dakota. Some gypsum, vanadium, uranium, lead, zinc, barite, fluorspar, potash and clay are produced in the temperate grasslands, but there are few areas of intensive mining activity.

Hazards

Many plant communities within the grassland biome contain plants poisonous to livestock. These plants may appear at various seasons during the year, or only at a specific season of the year. The entire plant may be poisonous or only a certain portion may be poisonous.

Many poisonous plants, when present in a healthy plant community, do not have an adverse effect on the herbivores. However, a disturbance of the healthy plant community may allow for an increase in the poison plant density so that a significant death loss of livestock may occur.

Other natural events--above normal moisture at precisely the right time, or freezing temperatures--can also cause a healthy plant community to become poisonous to some or all of the consumers of that community.

Some plants may be excellent forage when growing in certain locations. However, the same species will accumulate toxic amounts of elements such as selenium when grown in soil containing them. A good example of this is four-wing saltbrush.

Some locations within the biome have water that is extremely high in total soluble salts. Water that is high in soluble salt may be consumed by wild or domestic animals and, because of the amount of salt, the animal may not develop at its maximum capability. Other water may contain trace amounts of chemicals such as arsenic that can be lethal to both wild and domestic animals.

Aesthetics

The grassland may be described as primarily gently rolling hills and broad expanses of flatlands. In some areas near major streams, particularly in drier portions of the biome, continuity of the land may be interrupted by sharp breaks down to floodplains of the stream. Because of the relatively gentle slopes in the grasslands, few of man's activities interrupt continuity of the form. Where the form is disturbed, it is usually quite easily replaced to a natural or near-natural condition. Where the landscape is still in a natural state the soft texture of the grass-covered slopes is interrupted by occasional rock out-crops. In drier portions, ground cover may be in scattered patches with some exposed soil. Much of the eastern portion of the biome, along with the Palouse prairie and the California prairie, has been converted to agriculture. Here the texture changes from field to field as the crops change.

Although the texture of the grassland vegetation is easily disturbed, those areas that are still in a natural state can recover rapidly if given the opportunity to do so.

Lines in natural portions of the biome play a minor role in the landscape and are evident only in ridgelines and in the occasional road or powerline crossing through the area. In the agricultural areas, lines become much more obvious. Crop rows, field edges, fence lines and roads become a dominant element in the landscape.

Color is not a dominant factor in the grassland biome. It may play a more important role in moist agricultural areas, but in the natural and drier areas the colors are generally muted and tend toward a monotone.

Scale is difficult to define on the flat plane of the grasslands. Any vertical element that is introduced into the landscape has a tendency to define the scale, but also draws the eye and becomes a focal point.

The total effect of the landscape character of the grassland biome will vary with the individual observer. To one, openness may connote a freedom, room for movement, a challenge to action. Another may feel overwhelmed, lonesome, and unprotected. To some, it may seem a monotonous wasteland. To the acute observer, subtle changes in tone or forms may be fascinating.

Sound and smell, although they may be an important factor in a very localized area, are impossible to describe for an entire biome.

Human Interest Values

Geological

Human interest in geological phenomena tends to center on the features that are different and strange or beautiful and exciting. Things like volcanic necks, caves with stalagmite formations, sinks, natural arches and bridges, fossils, and erosional features arouse the interest and curiosity of the viewer. The grasslands biome has some of these features but, being primarily a flat landscape, they are rather limited.

The northern temperate grassland has colorful heavily eroded areas like the Badlands of the Dakotas, dome mountains like the Little Rockies, canyons such as in the Missouri Breaks, fossil beds, and volcanic remains such as Devils Tower in northeast Wyoming.

The southern temperate grassland contains limestone caves in the Pecos River region and sinkholes near Roswell, New Mexico.

The California prairie contains dome mountains (Marysville Buttes) in the vicinity of Sacramento and geologic faults with visible displacement, like the San Andreas Fault along its eastern edge.

The Palouse prairie contains interesting geologic phenomena such as the scablands, the Grand Coulee and other evidence of past volcanism in the region.

Archeological

The biome contains archeological sites depicting the three broad developmental stages of American Indian prehistory. These are the Paleo-Indian, the Archaic, and Agriculture stages.

Both the eastern Big-Game Hunting Tradition and the Western Old Cordilleran Tradition occur within the biome. The Big-Game Hunting Tradition is recognized in kill sites of such animals as the bison, mammoth, camel, and horse. More rarely campsites are found with chipping and other camp debris. Some cave sites have been found. The Big-Game Hunting Tradition has been recognized in the northern and southern temperate grasslands.

The Old Cordilleran Tradition represents a relatively unspecialized hunting-gathering-fishing way of life. Evidence comes from old lakeshore campsites, caves, and deeply stratified refuse dumps in favorite fishing spots. The tradition has been found in both the Palouse and California prairie grasslands.

The Archaic stage is found as a Plains Archaic Tradition in the northern and southern temperate grasslands. During this stage emphasis was placed on gathering of plants and some shellfish in addition to hunting.

In the Plains Archaic, this emphasis is indicated in the trash dumps, dry cave sites, burned rock debris mounds, and campsites. Bison and other animal kill sites continue to be found, some being buffalo jumps with rock alignments.

The Eastern Archaic is found in the eastern portion of the northern temperate grassland. It is similar to the Plains Archaic, but with more emphasis on gathering--especially shellfish.

The Desert Archaic tradition is found in the southern temperate grassland and had some input into the cultures found in the California prairie. The Desert Archaic subsistence pattern was based primarily on small seed gathering and small animal hunting. Archeological evidence comes mostly from campsites, dry caves, petroglyphs, and pictographs.

The Agriculture stage is represented in the northern temperate grasslands by the Plains Culture (Woodland and Plains Village Traditions). Although reverting to a strong hunting culture once again after the introduction of the horse in the 1700's, the Plains Culture base originally was agriculture. Sites are predominantly surface and pithouse village sites (some stockaded), tipi rings and other rock alignments, pictographs and petroglyphs, caves, buffalo jumps and animal traps, log structures, vision quest sites, pole structures, and burial mounds.

The eastern portion of the northern temperate grasslands also contains remains of the Agricultural stage, Northeastern Woodland Tradition people with their temple and burial mounds, large village sites, and occasional cave sites.

Evidence of the Agricultural Pueblo Tradition can be seen in the northern portion of the southern temperate grassland. Evidence of the Pueblo Tradition, here represented by the Mogollon Division, includes sites of masonry buildings, pithouse dwellings, occasional irrigation systems, trash mounds associated with villages, pictographs and petroglyphs, caves, fortified sites and roasting pits.

In the Palouse prairie, agriculture was never developed by the native inhabitants so that the final precontact periods are represented here by the Northwest Riverine Tradition. These people lived along the river valleys and their archeological sites are mostly the remains of pithouses and above-ground houses in villages along the rivers, campsites, quarries, petroglyphs, and burial grounds.

Similarly in the California prairie, the Agriculture stage never developed and the Archaic stage continued up to the time of contact with non-Indians. Large shell middens occur near water, quarries, and village sites.

Historical

Historically, this region has seen early explorations and ownership by the Spanish, French, English and Americans. During the fur-trading period, much activity took place and many trading posts were established. Army posts and camps constructed during the Indian Wars were, in part, concurrent with the fur trade. Immigration, railroads, gold seekers, and finally settlement by farmers and ranchers marked the conquest of the plains. These activities are marked by the remains and sites of old forts, trading posts, battlesites, cattle trails, railroads, mining ghost towns, homestead failures, and more recent ventures in oil, gas and coal extraction, and water reclamation.

The northern temperate grasslands were considered, because of their dryness and the Indians, as a barrier to movements to the more fertile areas of the West. Consequently, much of the history here involves Indians, soldiers, and immigrants passing through.

The southern temperate grasslands were explored in the 16th century by the Spanish, but little settlement took place. No real inroads into settling the various parts of the biome occurred until about 1850 with the advent of gold discoveries in California and the Rocky Mountain west.

The California prairie received some settlement in the Mexican Period, but its agricultural greatness began as a supplier of foodstuffs for the 49'ers. The Palouse prairie too was settled as an agricultural area in the mid-1800's.

Cultural

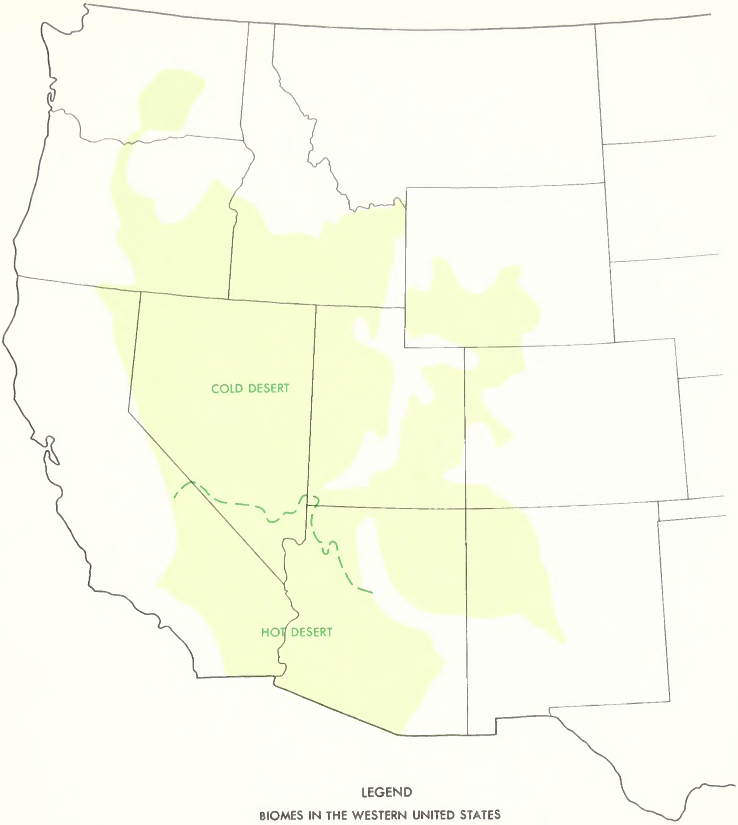
Most prominent of the minority groups occupying the grassland biome are American Indian groups still living on the various reservations and using, to some extent, their lands for religious and cultural activities. In the southwestern portion of the biome are Spanish-American communities whose life-style is still dependent on traditional land uses outside their villages. Other ethnic-cultural-religious groups include Amish and Mennonite settlements in Iowa and Kansas, the monastaries and abbies, and various religious cults in California.

Many of the native cultures attach religious or mythological significance to specific sites. Disturbance or intrusion upon these sites by others may seriously affect their religious values. Many other ethnic and religious groups have needs such as appreciation of their value systems and recognition of their desires to be left alone.

Desert Biome

The desert biome in the United States occupies an extensive area between the coniferous forests in the Rocky, Cascade, and Sierra Nevada Mountains. It is found at elevations below the woodland-bushland types and in other areas where precipitation is too low to support grassland or woodland vegetation. It includes two subtypes--cold deserts and hot deserts. The former have warm summers and cold winters; the latter have moderately warm winters and extremely hot summers. The location of the two types of desert are mapped in Figure II-13.

The cold desert extends through central Washington, eastern Oregon, southern Idaho, southwestern Wyoming, northeastern California, most of Nevada, Utah, northern Arizona, northwestern New Mexico, and extreme western Colorado. It includes islands and fingers of grassland and woodland types (49). Parts of it are referred to as the High Desert, Great Basin Desert, or Painted Desert.



LEGEND

BIOMES IN THE WESTERN UNITED STATES

I. GRASSLAND BIOME
  1 Temperete Gressland
  2 Pelouse Preirie Grasslend
  3 Californie Preirie Gresslend
II. DESERT BIOME
  1 Cold Desert 🟩
  2 Hot Desert 🟩
III. WOODLAND-BUSHLAND BIOME
  1 Broed Sclerophyll
  2 Oak Woodland-Bushland*
  3 Juniper Associates*
IV CONIFEROUS BIOME
  1 Northwest Coastal Forest
  2 Montane Forest

(*Generally included within the desert biome boundary.)

FIGURE II-13 DESERT BIOME

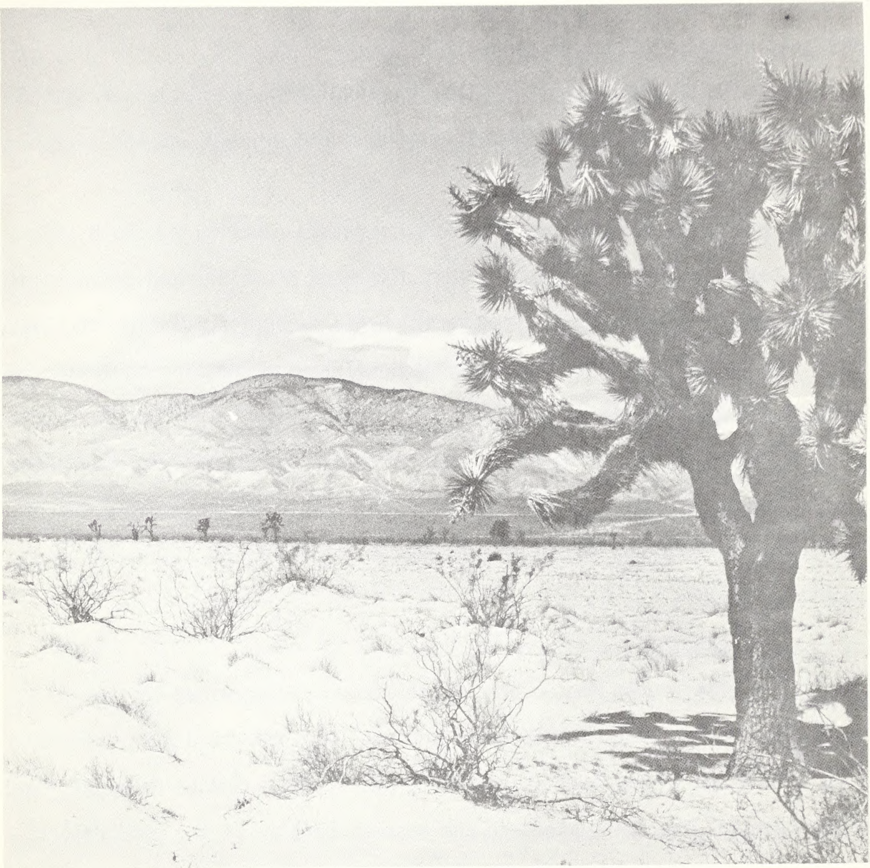


Figure II-15. The hot desert

Entisols are young and essentially nondeveloped. Entisols are formed in recent alluvium, recently stabilized sand dunes, or on steep slopes subjected to rapid soil creep. Entisols are located in south-central Oregon, western Nevada, and central Utah.

The soils of the hot desert biome are Aridisols. The soils in southeastern California, southern Nevada, and southern Arizona are hot, dry, and low in fertility.

The Aridisols contain two suborders: Orgids and Orthids. Both suborders have a hardpan, or duripan, but differ in structure and composition. The hardpan developed under the suborder Orgid is an accumulation of clays; under the suborder Orthid is found an accumulation of calcium carbonate, gypsum, and other salts.

The desert soils are highly susceptible to wind and water erosion because they are single-grained and easily detached. They are quite susceptible to erosion processes when disturbed by machines and removal of the vegetative cover.

Minerals

The predominant mineral resource now being mined in the biome is copper. Most of the copper produced in the United States comes from this biome. Many very large, low grade deposits are being mined. Coal and phosphates are being mined in the eastern portion of the cold desert. Other mineral operations occur throughout the biome. These include, but are not limited to silica, gypsum, sodium, perlite, iron ore and tungsten. Oil shale extraction may begin in the eastern part of the cold desert. Potential geothermal steam sources for power generation are being explored in areas such as the Imperial Valley on the Mojave Desert.

Leasing and exploration activity is increasing, especially in the Great Basin portion of the cold desert. Nearly all of the current production of oil and gas in the desert biome is limited to the eastern edge of the desert in Wyoming, Utah, Colorado, and New Mexico. Because of thin soil cover, it is relatively easy to explore for minerals. Rockhound mineral collecting occurs for gem stones such as agate, opal, jasper, and garnet.

Water

Parts of the Columbia-North Pacific, Great Basin, Upper Colorado, and Lower Colorado drainage basins are located in the desert biome. The major rivers of the biome are the Snake, Columbia, Humboldt, Green, and Colorado; they receive most of their runoff from precipitation in the higher elevations above the desert. Many streams within the arid desert biome are intermittent.

The Great Basin water resources region is a closed basin. Its surface waters drain into inland water bodies such as Great Salt Lake, Sevier Lake, Pyramid Lake, and Humboldt Sink.

Runoff from the desert is low and fluctuates widely from one year to the next. Average annual runoff ranges from less than 0.1 inch in the most arid sections of the hot and cold deserts to more than two inches in less arid parts of the cold desert.

The quality of surface water in the desert biome is adequate for most purposes. However, in the lower Colorado region and Great Basin, some surface waters have high dissolved-solids content and/or suspended-sediment concentrations. Average dissolved-solids content ranges from less than 100 ppm in part of the Columbia-North Pacific region to more than 1,800 ppm in some areas of the Great Basin and Lower Colorado regions. Average suspended-sediment concentrations range from less than 280 ppm in part of the Columbia-North Pacific region to more than 30,000 ppm in northern Arizona and southwestern Utah. Suspended-sediment concentrations as high as 700,000 ppm have been measured during peak flows on some streams in the Colorado River system.

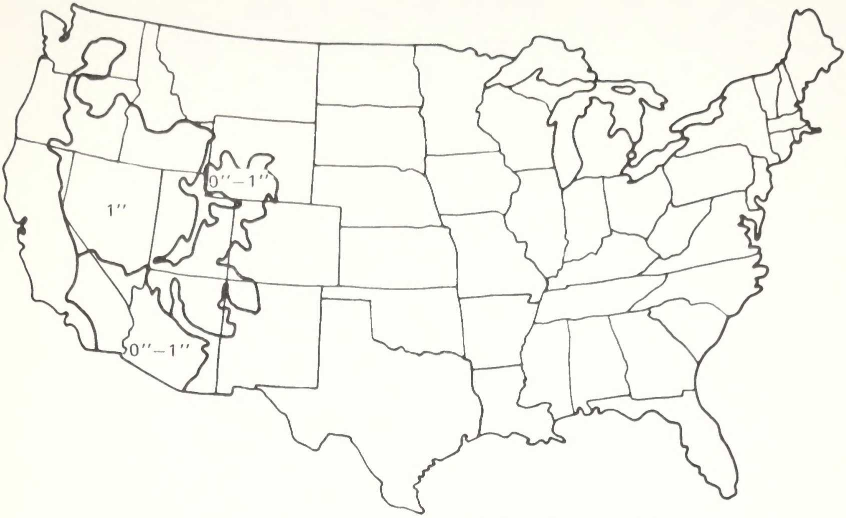
Climate

The climate of the desert biome is characterized by low, erratic precipitation, strong winds (especially in the spring), and hot summer temperatures.

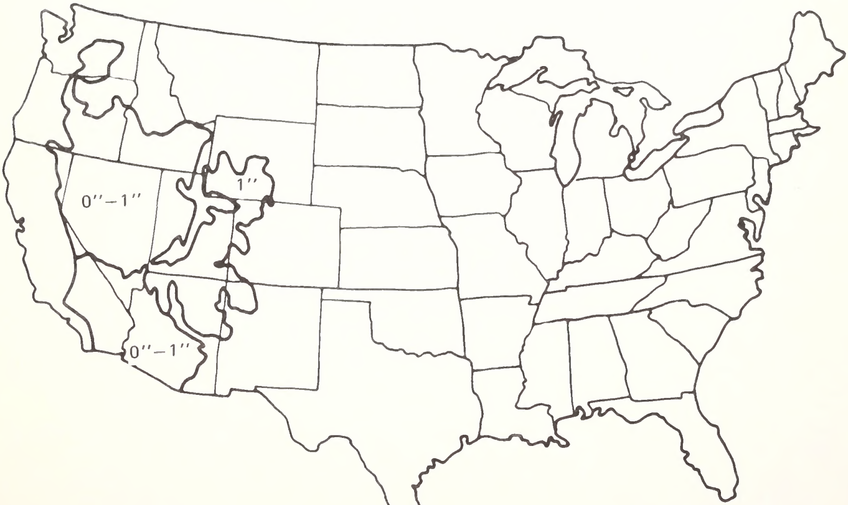
The cold desert lies in a belt of westerly cyclonic storms. The storms bring most of the annual precipitation to most parts of the cold desert during winter and early spring months (Figure II-16). The average annual precipitation ranges from 4 inches in the desert valleys to 16 inches on the higher plateaus.

Temperatures range from 20 degrees F below zero to 115 degrees F. Mean daily temperatures range from 20 degrees F in January to 75 degrees F in July (Figure II-17).

Mean wind direction and velocities vary little between winter and summer (Figure II-18). Spring is the windiest time of the year, with winds of 40 mph not uncommon. Strong spring winds carrying sand sculpture the desert landscape. Temperature inversions cause blankets of fog to cover inland basins for several days at a time (Figure II-19). In some areas, the inversions trap pollutants and pose serious air pollution problems for relatively short periods.

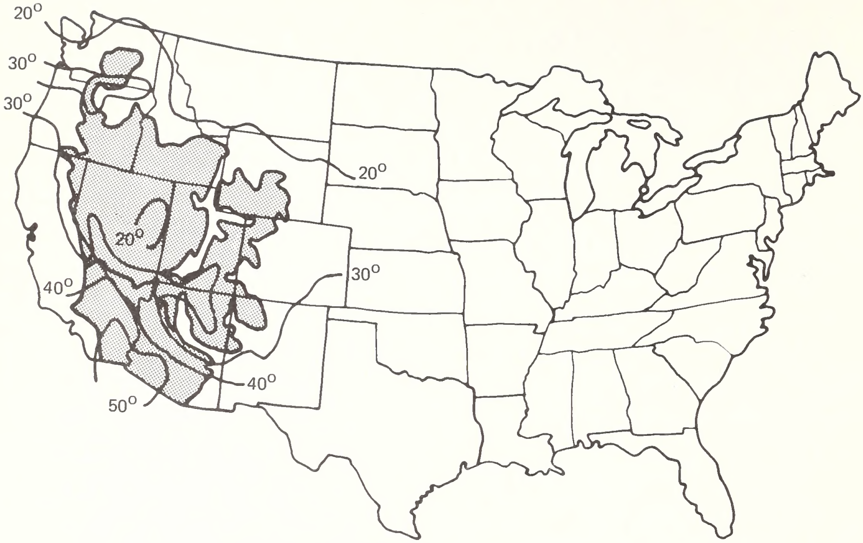


MONTHLY PRECIPITATION (INCHES)–JANUARY

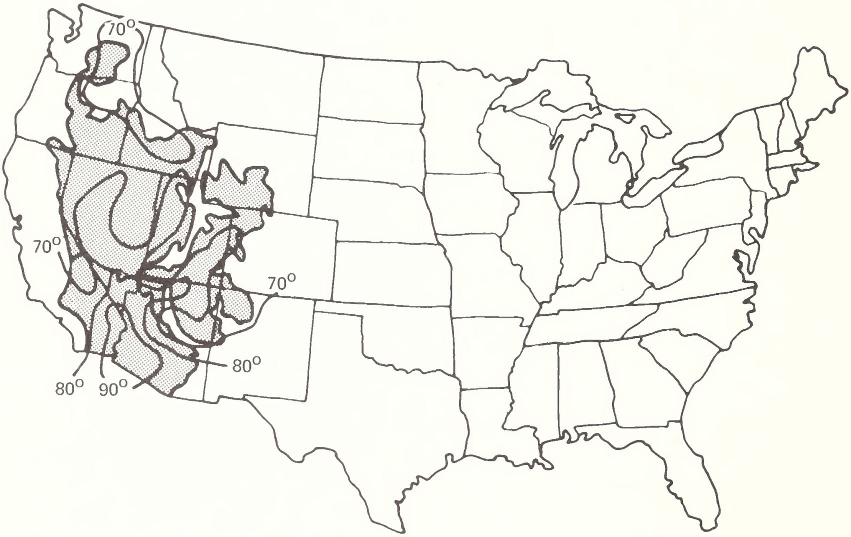


MONTHLY PRECIPITATION (INCHES)–JULY

Figure II-16. Average January and July precipitation in the desert biome

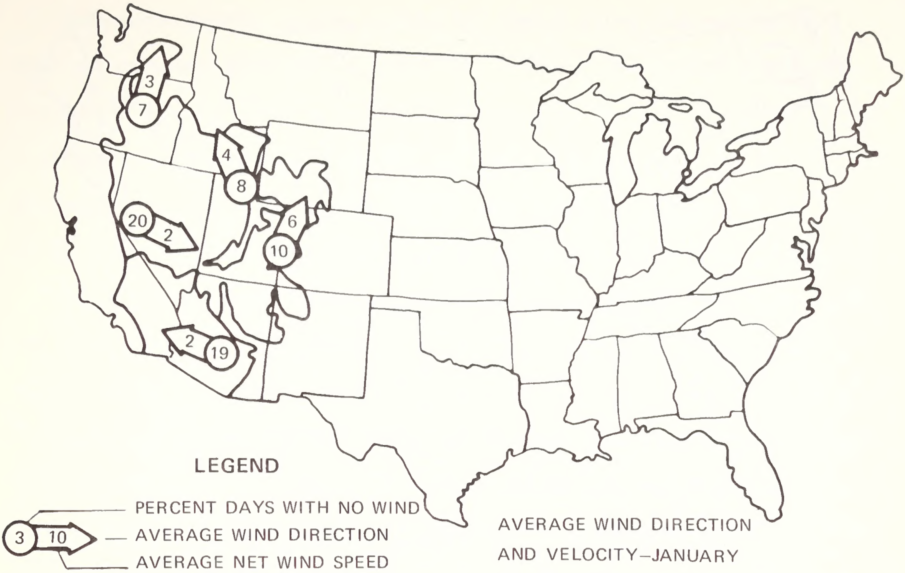


AVERAGE DAILY TEMPERATURE (0°F)—JANUARY

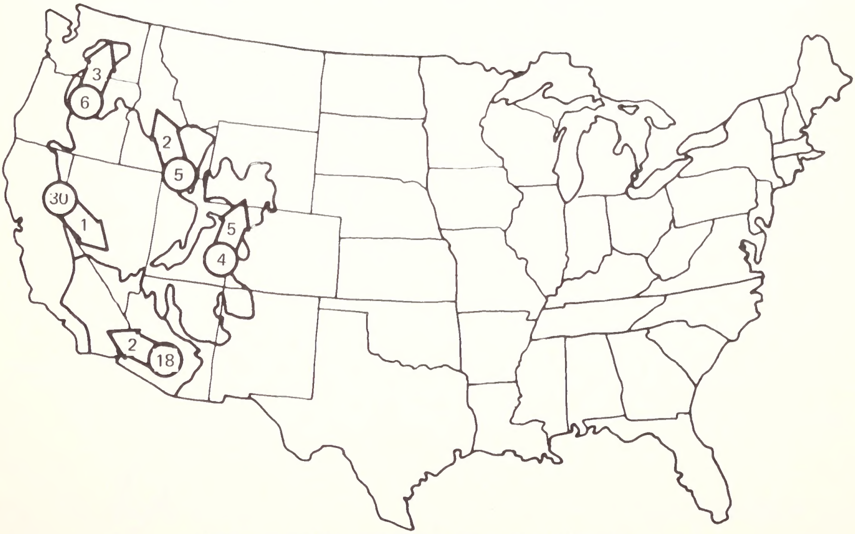


AVERAGE DAILY TEMPERATURE (0°F)—JULY

Figure II-17. Average daily temperatures in the desert biome in January and July

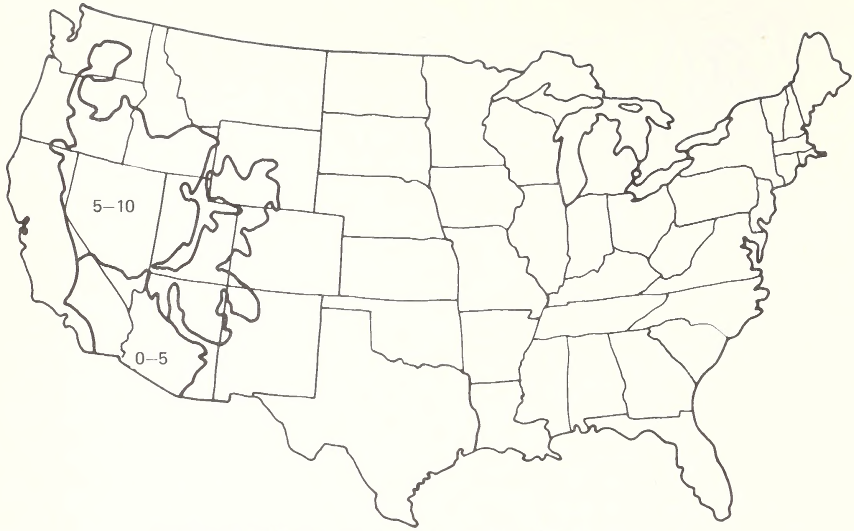


AVERAGE WIND DIRECTION AND VELOCITY–JANUARY

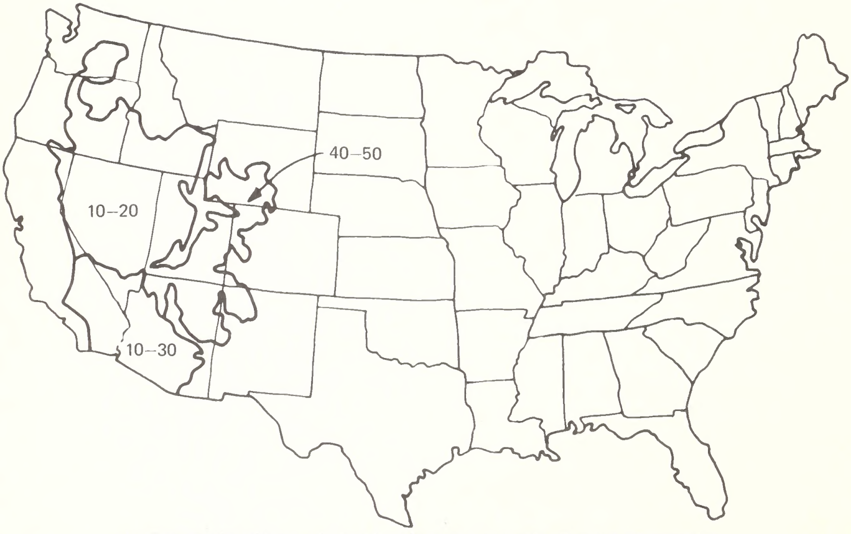


AVERAGE WIND DIRECTION AND VELOCITY–JULY

Figure II-18. Average wind direction and velocity in the desert biome in January and July



AVERAGE NUMBER OF DAYS ANNUALLY WITH DENSE FOG



AVERAGE NUMBER OF DAYS ANNUALLY WITH THUNDERSTORMS

Figure II-19. Average annual number of days with fog and days with thunderstorms in the desert biome.

Infrequent frontal systems in the hot desert bring some moisture in from the west and north during the winter. During the summer, scattered thunderstorms drop moisture in the desert (Figure II-18). Infrequent penetrations of moisture occur from the Gulf of California, the Pacific, and the Gulf of Mexico. The average annual precipitation ranges from two inches in the lower Imperial Valley to eight inches in the remainder of the area.

Temperatures range from 25 degrees F to 125 degrees F above zero. The mean daily temperature varies from 55 degrees F to above 90 degrees F in July (Figure II-17).

Spring months tend to be windy, and sand-carrying winds of over 40 mph are not uncommon. Late summer thunderstorms are more common in the hot desert than in all sections of the cold desert except central Wyoming; in that area, thunderstorms occur 40 to 50 days per year.

Climate varies widely from one area to another and from one year to another in the desert biome.

Living Components

Vegetation

The desert supports an extensive community of plants. Four lifeforms are common:

1. The annuals, which adapt to drought by growing only when moisture is adequate.

2. The succulents, such as the cacti, which adapt to drought by storing water.

3. The desert shrubs, which have numerous branches originating from a short basal trunk bearing small, thick leaves that may be shed during prolonged dry periods (2).

4. Perennial grasses and forbs.

All desert vegetation has a highly characteristic spaced distribution. Individual plants are thinly scattered and separated by large bare areas. The extensive bare ground, however, is not always free of plants. Mosses, algae, and lichens may form a stabilizing crust and function as nitrogen-fixing agents.

The cold desert is characterized by sagebrush, greasewood, shadscale, and saltbrush. Creosote bush, yucca, and cactus typify the hot desert. A considerable amount of grass is mixed with the shrubs in the eastern parts of both deserts.

Unlike the grasslands and the forests, where vegetative renewal on disturbed areas is relatively rapid, the desert is essentially lacking in plant succession. If a desert plant community is denuded, the plants that ultimately return are usually the offspring of the original species. Exceptions often take the form of such noxious species as halogeton which is poisonous to sheep and cattle. There is no special successional series of weeds, grasses, shrubs, and trees--with each stage preparing the soil or providing shade for the following stage as in a forest. The restored community is the one that was there in the beginning. It may take decades to reestablish itself.

Animals

Terrestrial Wildlife

Animals have adapted to the environment of the desert in unique ways. Animal life in the biome is characterized by mammals and birds which are fleet of foot; mammals which move by jumping or with a ricocheting locomotion; mammals with a keen sense of hearing; burrowing vertebrates, and various insects--all having an extreme physiological adaptation to food scarcity and absence of free water (50). Some desert animals, such as the kangaroo rat and pocket mouse, do not need to drink water. Others drink water only occasionally. Birds of the desert obtain sufficient water from foods, occasional dew, and free water sources. Many animals of the hot desert avoid extreme temperatures by burrowing or occupying caves; many are nocturnal.

More than 750 species and subspecies of birds and mammals live in the lower Colorado basin. Many of the species may occupy only the fringes of the desert, and then only seasonally. Mule deer and bighorn sheep occur in suitable habitat of the desert. Carnivores in the desert are small and usually nocturnal. Species of kangaroo rats and pocket mice are found throughout the hot desert; both are nocturnal burrowers.

Animals of the Lower Colorado River Desert include the mule deer, bighorn sheep, jackrabbit, desert coyote, kit fox, antelope ground squirrel, cave bat, big brown bat, leaf-nosed bat, lesser nighthawk, road runner, and Gambel quail.

The Sonoran Desert provides a habitat for mule deer, bighorn sheep, the ringtail, spotted skunk, wood rat, peccary, Gila woodpecker, numerous small birds, bullsnake, three species of rattlesnake, and eight species of lizards. The Gila monster is typical of the cactus community. The river bottoms and flood plains include some 32 kinds of birds.

The Mojave Desert has fewer species of pocket mice and the Gila monsters are of more limited occurrence. Otherwise, many of the animals--with some differences in subspecies--are the same as those in the Sonoran Desert, with the desert iguana and desert tortoise being common. Death Valley, an example of desert habitat, has 39 desert mammals and approximately 100 species of birds (41). Certain insects perform critical functions in the desert, such as the Yucca moth which pollinates the Joshua tree.

Many of the hot desert animals are found in the sagebrush and shadscale of the cold desert. Major tenants however, are the Great Basin coyote, badger, antelope, mule deer (locally), great horned owl, prairie falcon, Swainson's hawk, golden and bald eagles, horned lark, and horned toad. There are few reptiles (41).

Aquatic Wildlife

Aquatic environments are limited in the desert biome. Diversions of water for agriculture and other uses have impaired some aquatic communities such as the deterioration of fish habitat in Pyramid and Walker Lakes, Nevada--the home of Lahontan cutthroat trout and the depleted cui-ui sucker (51).

Water quality varies from the high quality desert-mountain snow water to such low-quality alkaline lakes as the Salton Sea.

Desert aquatic environments have been altered by the construction of large reservoirs--Lakes Powell and Mead--and many small irrigation and stock-watering reservoirs. Exotic species such as black bass, crappie, carp, sunfish, coho salmon and striped bass have been introduced in some reservoirs. The Corvina, Sargo, and Bairdiella have been introduced in the

Salton Sea. Most of these introductions have been successful while many endemic species have declined.

Threatened Wildlife (42,51)

Many threatened species of wildlife are recognized in the desert biome. These include, but are not limited to: Utah prairie dog, Sonoran pronghorn, spotted bat, masked bobwhite quail, Yuma clapper rail, southern bald eagle, American peregrine falcon, prairie falcon, and Vegas valley leopard frog.

There are more threatened species of fish in the desert than in any other biome. This is due in part to the many isolated watersheds and the precarious nature of many water bodies. Typical species include: Devil's Hole pupfish, Owens pupfish, Woundfin, Desert dace, Pahrump killifish, Gila topminnow, and Colorado squawfish.

Domestic Livestock

The desert biome produces a variety of forage species suitable for domestic livestock forage. Both cattle and sheep are grazed throughout the biome.

Because of variations in climate in the cold desert, livestock grazing may occur during any season depending on location. In the northern third of the biome, livestock grazing is very limited in the winter season because of severe winter storms. Spring and fall grazing is most common with some winter grazing of sheep occurring where the climate permits.

Parts of the hot desert are grazed by cattle year-long. Some sheep grazing occurs, but it is limited to the winter season.

In about one year out of five, unusually abundant precipitation in the hot desert produces a good crop of winter annuals. Livestock grazing increases during the brief period the annuals are available.

Although forage is especially suitable for sheep grazing, the number of sheep in the desert has declined over the years generally because of economic factors.

Wild Horses and Burros

Bands of wild horses and wild burros roam several ranges in the hot desert uplands and remote areas of the cold desert.

The greatest number of wild horses and burros on NRL occur in the intermingled cold desert biome and the pinon-juniper type of the woodland-bushland biome. About 90 percent of the estimated 17,000 wild horses occur in this association, with Nevada having the most and the widest distribution. Competition with livestock and wildlife for forage does occur. Distribution of wild horses is limited to remote, less accessible portions of the public lands inhabited by deer and antelope. An estimated 10,000 wild burros populate the hot desert region of Arizona, California, and Nevada, where competition for forage with other grazing animals is prevalent.

Soil Organisms

Soil organisms play the same role in soil development in the desert biome as in the grassland biome. However, organic matter is more limited in desert soils and its breakdown by microorganisms such as nematodes and protozoa is slower. Conditions for the growth and activity of the mircoorganisms is less favorable in the desert biome; although the soil is often warm enough, moisture usually is insufficient. Due to excessive salt concentrations, some desert soils are largely devoid of plant life and the microorganisms that would help develop conditions to support plant life (52).

Human

About 17 percent of the western states' population resides in this biome. Except for the hot desert region of southern Nevada, California and Arizona, the desert biome has one of the lowest population densities in the West--around five persons per square mile. Urban populations are clustered around the major trade and service centers such as Phoenix, Salt Lake City, Las Vegas, Reno, Boise, and the urban areas of California.

In the rural areas, per capita income levels are about 85 percent of the western average, but relatively fewer families are below poverty levels due to lower living costs.

In spite of the low incomes, most of the biome experienced a net population gain during the 1960-1970 period. Population gains from 1960 to 1970 in sparsely populated areas of Nevada and Arizona, for instance, exceeded the national growth rate of 13.3 percent (48).

The entire area is dependent upon a limited water resource. Principal industries in rural parts of the biome are agriculture and mining. Urban centers tend to be new and modern, with growing manufacturing and service oriented industries. The Reno and Las Vegas areas have expanded entertainment and tourist service into a major industry (53).

One of the reasons for significant population and economic growth in the biome during recent years has been its "amenity" resources: clear air, warm and cloudless weather, low population, and ready access to outdoor recreation areas. Tourism and recreation are growing rapidly. Subdivisions and sale of lands for retirement or recreational use are mushrooming in many rural areas. In urban areas, the "quality environment," ready access to services, educational institutions, and a labor market form a magnet for industries for which ties to raw material sources or national market centers are not a major constraint. Typical of these are apparel, electronics, and aircraft industries (54).

The livestock industry of the desert biome ranks between the grassland and coniferous forest biomes in terms of economic importance to local incomes. However, the livestock industry is this biome is much more dependent on national resource lands as a source of feed than in either of the other two. For example, in the Great Basin Area (central and northern Nevada, western Utah, southwestern Idaho, and southeastern Oregon), the national resource lands account for about 60 percent of the total land areas and provide about 20 percent of the total livestock feed. On the other hand, in the hot desert area, national resource lands account for about 38 percent of the land area, but provide only around three percent of the feed consumed. The high concentration of feedlot operations in this region accounts for much of the difference between the two regions. For the biome as a whole, the NRL supply 5,990 cattle AUMs and 1,970,000 sheep AUMs.

Ecological Interrelationships

Desert ecosystems are exceptionally vulnerable to improper use and may reflect this quickly through accelerated wind erosion and in other ways. Recovery rates are slow. Although the desert has been the subject of many studies and books, the interrelationships of the desert ecosystems are not well known. Additional studies are needed, especially in view of the delicate ecological balances of the desert ecosystems. The disturbance of vegetative cover and loosening of soil, as in road construction, can result in rapid invasion of such non-native plants as halogeton, causing an entirely different ecological relationship in the immediate area.

Precipitation is low in desert ecosystems and varies considerably from year to year. Evapotranspiration is high, particularly in the hot desert and southern portions of the cold desert. The limited soil moisture in southern parts of the desert limits the potential for production of living components of the ecosystem.

Solar radiation is high in the desert, but the amount of energy captured by photosynthesis is greatly reduced due to the limited moisture and sparse vegetation. Such factors reduce the productive capacity of the desert and shorten the food chain.

The nutrient cycle occurs slowly in the desert because of the slow rate of decomposition. Large quantities of nutrients are tied up in the shrubby vegetative biomass. Man's use of the desert has altered the balance of the nutrient cycle in some areas. Additional data are needed to fully understand this component of the ecosystem and analyze impacts.

Natural successional recovery of desert communities from man-caused disturbances is extremely slow, especially in the hot desert.

Land Uses

Most of the land in the desert biome is owned by the Federal overnment. Extensive areas are used for military operations and other government purposes, such as Atomic Energy Commission test grounds. Most of the federal lands in the biome are national resource lands administered by the Bureau of Land Management.

The native vegetation covering a major part of the biome is used for livestock grazing, the most extensive agricultural activity in the biome. Both cattle and sheep are grazed in the desert. The former are primarily cow-calf operations; the latter are oriented toward lamb production. Natural vegetative productivity for grazing decreases, generally, from north to south in the biome. Parts of the hot desert are marginal grazing lands, and some areas are unsuitable for livestock use.

Irrigated crops in the cold desert include potatoes, sugar beets, grains, and hay. Subtropical fruits, cotton, and specialty crops are grown in the hot desert. Large areas of irrigable soils remain unirrigated in the desert because of inadequate water supplies.

A few areas in the biome have been formally designated and managed as wilderness, primitive, or roadless areas. Additional areas containing native vegetation and lacking significant development (such as roads, buildings, or other facilities) may be considered for formal designation as land use planning progresses.

Mining was responsible for much of the original settlement of the biome. Many of the early towns started as gold or silver camps. Mining continues today to be a primary industry in the States of Colorado, Arizona, New Mexico, Utah and Wyoming. The exploration and production of oil and gas makes a significant impact on the economy and environment in the desert biome.

The desert is extensively used for outdoor recreation. Heaviest use occurs near large population centers. The western part of the hot desert adjacent to the Los Angeles-Las Vegas-Phoenix urban areas receives extremely heavy use.

The limited surface waters in the biome are heavily used for recreation activities. Heavy off-road vehicle use is occurring close to urban areas.

Metropolitan areas in the desert have grown rapidly in recent years. The Las Vegas urban population increased 165 percent between 1960 and 1970 (48). The urbanized area increased from 35 square miles to 121 square miles. Other metropolitan areas such as Phoenix and Salt Lake City experienced similar growth. The extraordinary growth of metropolitan areas in the desert may continue for several decades. If so, large areas of adjacent rural land may be required for expansion.

Urban areas in the biome are separated by vast areas of open space.

Smaller cities serving a local market area or developing a tourism - recreation industry probably will experience an increased demand for residential, commercial, and industrial land uses.

Demand for recreational or retirement homesites in remote areas probably will continue to increase.

Hazards

Plants poisonous to wildlife and domestic livestock occur at various seasons throughout the biome. The general description of characteristic occurrences of poisonous plants in the environment is discussed in the grassland biome. Throughout the biome and especially in those areas where historic prospecting and mining for gold and silver took place, mine shafts, portals, and pits, present significant hazards to the public, particularly unsuspecting recreationists.

Aesthetics

The term "desert" for many people carries with it a connotation of sand dunes and desolation. While it is somewhat inhospitable for man, the connotation is far from accurate. It may, however, be partly responsible for the lack of development and use of the desert in the past. People are just now discovering the desert for the wide variety of interests it really has. There are sand dunes in both the cold and hot deserts, but they involve a very minor part of the area as a whole. The dunes are one more interesting facet of the desert that people are finding more and more enjoyable.

Although there are many similar characterisitics throughout, the desert biome can be more clearly described in the two separate sections.

The land form of the cold desert is typically the flat dry bed of an ancient lake or the relatively low rolling hills of the Great Basin, occasionally interrupted by a small mountain range. Seldom is the observer out of sight of a mountain somewhere in the area of view. Texture of the cold desert is generally the relatively soft texture of the vast expanses of sagebrush broken occasionally by a bare ridgeline, a steep gully, or a flat dry lakebed.

Color is rather monotonous in the cold desert. It is generally dominated by the gray-green of sagebrush or the flat grays and browns of the soil typical to the region. Soil color becomes a more important factor in some portions of the cold desert such as in Wyoming and Colorado and New Mexico where the red sandstones make up the parent material.

Lines play a very minor role in the makeup of the character of the cold desert. Lines that are evident are primarily those caused by man: roads, fences, and powerlines that occasionally cross through the area. Although these intrusions are few, they are obvious for many miles.

As in the grasslands, scale is difficult to define. Vastness of open space with few vertical elements in the landscape make it hard to tell just how far an observer is from a given object.

The character of the hot desert is considerably different than that of the cold desert. Form is more often remnants of eroded mesas with broad flat valley bottoms. Where live streams run through the desert, they often are actively eroding the land; and steep, sometimes vertical-walled canyons are incised into once flat mesas. Prime examples of this area are the canyons of the lower Colorado River.

There are distinct horizontal and vertical lines evident in the mesa tops and sharp drop-offs to the valley floors. Color becomes a dominant factor in the hot desert. Rich reds and browns of exposed soil and rocks are much more in evidence than in the sage-covered cold deserts.

Texture is fairly coarse because of the widely scattered vegetation. Rock and soil are exposed over much more area.

Scale is much easier to define in the hot desert. Vertical lines created by edges of eroding mesas along with the larger and more scattered vegetation provide the observer with the elements needed to more accurately judge size and distance.

Sound and smell have almost no bearing on the description of the present environment, although introduction of either would be immediately noticeable, at least in localized areas.

Human Interest Values

Geological

Deserts have some of the most monotonous sightseeing geology and some of the most intriguing. The basin and range areas of Nevada tend to be somewhat repetitive with long sweeping views of the basins and short quick trips through the mountain ranges.

Certain areas, particularly the Colorado Plateau, are highly eroded, mostly in colorful formations which contain delicate erosional features, easily recognizable "picture book" geological structures, and grand views of the total. Scattered throughout the biome are some of the most magnificant canyons in the world, the Grand Canyon, the canyons of the Snake, the Owyhee, the Green, and others. Also present are sand dunes, volcanic features, playas, and fault structures.

Archeological

In the desert biome are found remnants of both Big-Game Hunting Tradition and Old Cordilleran Tradition cultures, the former to the east and south and the latter to the north and west. Hunters in southeast Arizona hunted mammoths along with other big game. People in the Nevada desert were mostly gatherers, but did hunt small game, including waterfowl, around the many Pleistocene lakes in the region.

These two traditions developed into what is termed the Desert Culture Tradition, a basic gathering culture that existed on the many grasses, pinons, insects, small game, and other products of the hot and cold deserts.

From this desert archaic base there developed, as the result of strong influences from the valleys of Mexico, several agricultural cultures in the hot desert and the southern portions of the cold desert.

Irrigation farming was practiced, large communal structures constructed, and highly organized and structured social systems developed. At the same time period, there also were people with the desert archaic tradition still coexisting and others like the Apachean groups moving into the desert area. This was the situation at the time of first non-Indian contact (by the Spanish explorers) in the early 1500s.

Large archeological sites of the desert biome are quite easy to detect, but attention paid to these sites tends to allow other, less pretentious sites like agricultural terraces, campsites, chipping areas, small canals, and shallow caves to be destroyed.

There is almost a one-to-one relationship between archeological sites and water sources in the desert. Water sources were as important to prehistoric man as for modern man.

Historical

Like most of the West, history of the desert biome is generally so recent that some individuals still living there have seen 90 percent of the important historical events that have taken place.

Most of the settlement has taken place in the last 100 years. Only in southern parts of the hot desert is civilization older due to the Spanish and Mexican settlement. The Great Basin portion of the cold desert is the least inhabited area in the country with history revolving around mining ghost towns and the ranching industry. In the hot desert, irrigation agriculture has been a way of life from prehistoric times. Other than these influences, historical values are similar to those of the grasslands.

Cultural

There are some interesting cultural-ethnic and religious groups in the desert biome. In Nevada and southwest Idaho are groups of Basques originally brought to this country as sheepherders from the Pyrenees Mountains of Spain. In Utah, Arizona, and Nevada are the Mormons, a religious group which is a minority in the United States, but a majority group in the desert biome. The Yaquis near Tucson are native Americans living here as a political refugee group from Mexico. A great number of native Indian Americans live on reservations in the biome. These range from farmers like the Pimas and Papagos to hunting-gathering peoples like the Yavapai and Paiutes. All of the Indian groups have a strong attachment to the lands around their areas of settlement.

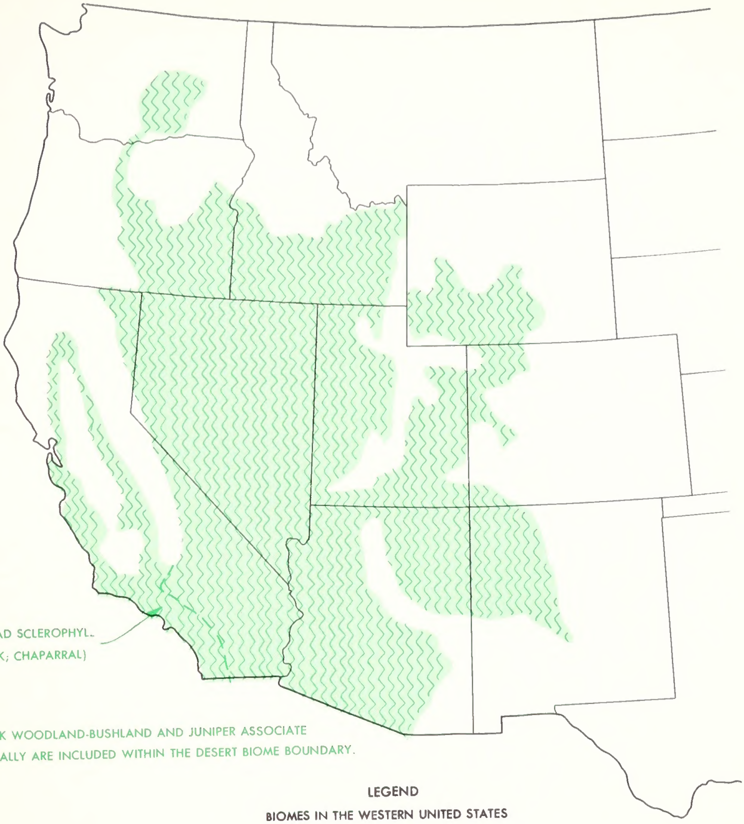
Woodland-Bushland Biome

The woodland-bushland biome (or biological community) occurs in many parts of the western United States. It is discontinuous, occurring as biological islands at higher elevations within the grassland and desert biomes. It also forms a transitional zone between those biomes and the coniferous forest biome. Its general range is shown in Figure II-20. Many of its vegetative characteristics are similar to the cold desert. Figures II-21, 22, and 23 illustrate the oak woodland-bushland, broad sclerophyll, and the pinon-juniper communities, the three species associations in the biome.

Non-Living Components

Topography

Much of the woodland-bushlands are located on the high hills and mesas in and adjacent to the deserts. The description of the topo-



BROAD SCLEROPHYLL

(OAK; CHAPARRAL)

THE OAK WOODLAND-BUSHLAND AND JUNIPER ASSOCIATE GENERALLY ARE INCLUDED WITHIN THE DESERT BIOME BOUNDARY.

LEGEND

BIOMES IN THE WESTERN UNITED STATES

I. GRASSLAND BIOME
- 1 Tamperata Grassland
- 2 Palousa Prairie Grassland
- 3 California Prairia Grassland

II. DESERT BIOME
- 1 Cold Dasert
- 2 Hot Dasert

III. WOODLAND-BUSHLAND BIOME
- 1 Broad Sclarophyll <<
- 2 Oak Woodland-Bushland* <<
- 3 Juniper Associates* <<

IV CONIFEROUS BIOME
- 1 Northwest Coastal Forest
- 2 Montane Forest

(*Generally included within the desert biome boundary.)

FIGURE II-20 WOODLAND-BUSHLAND BIOME

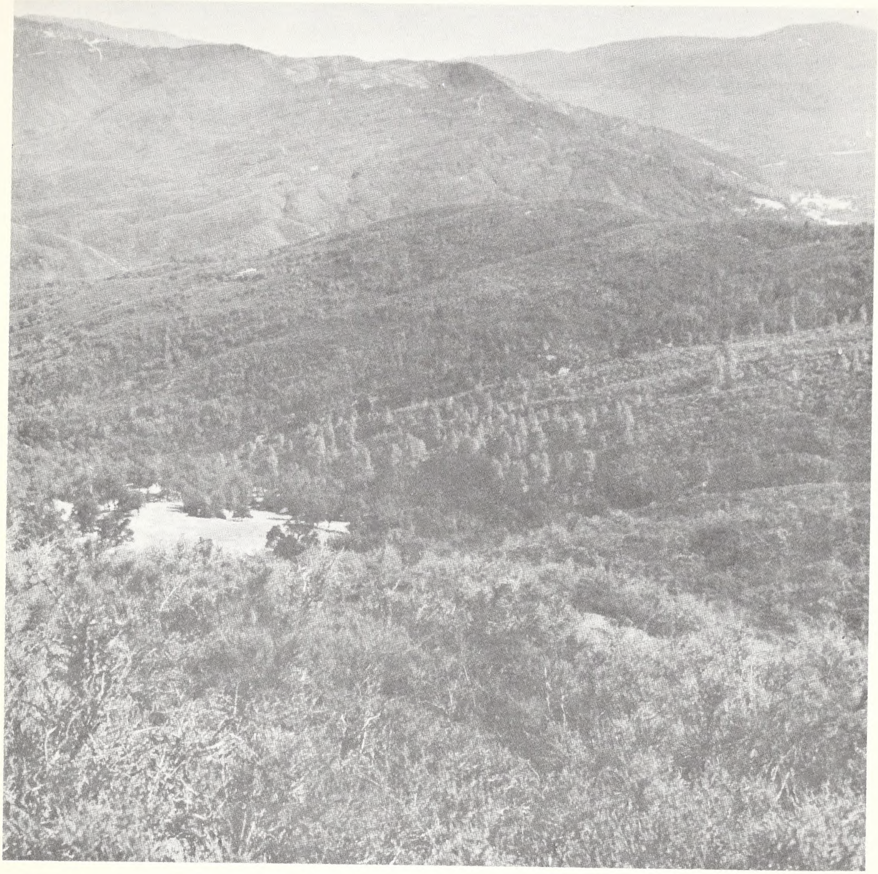


Figure II-21. The broad sclerophyll (oak-chapparal) community

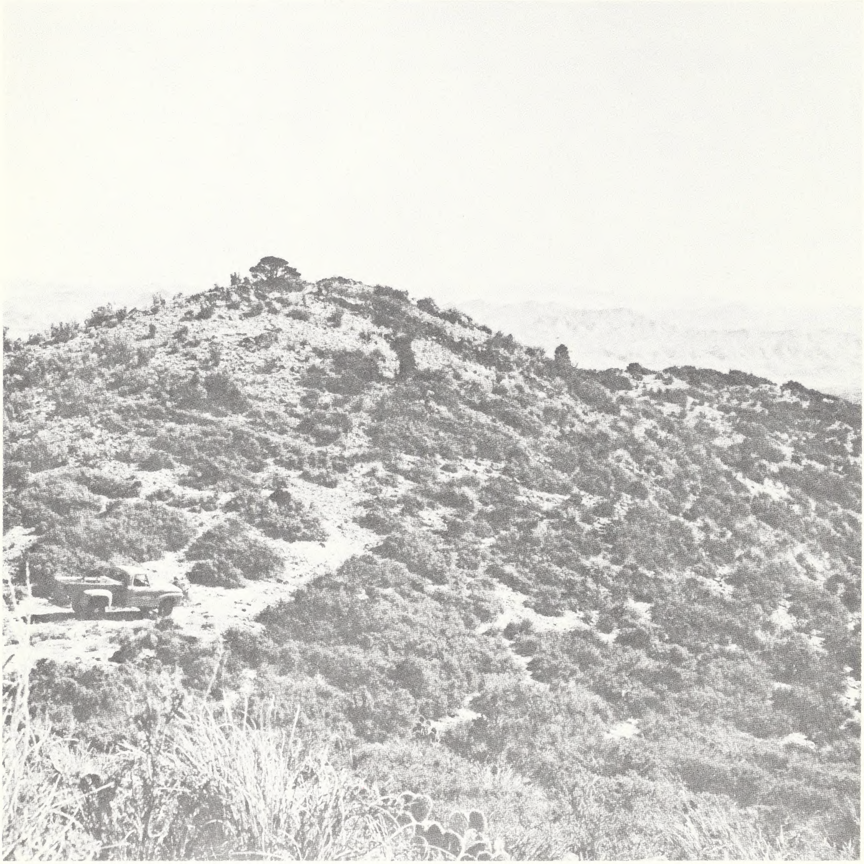


Figure II-22. The oak woodland-bushland community

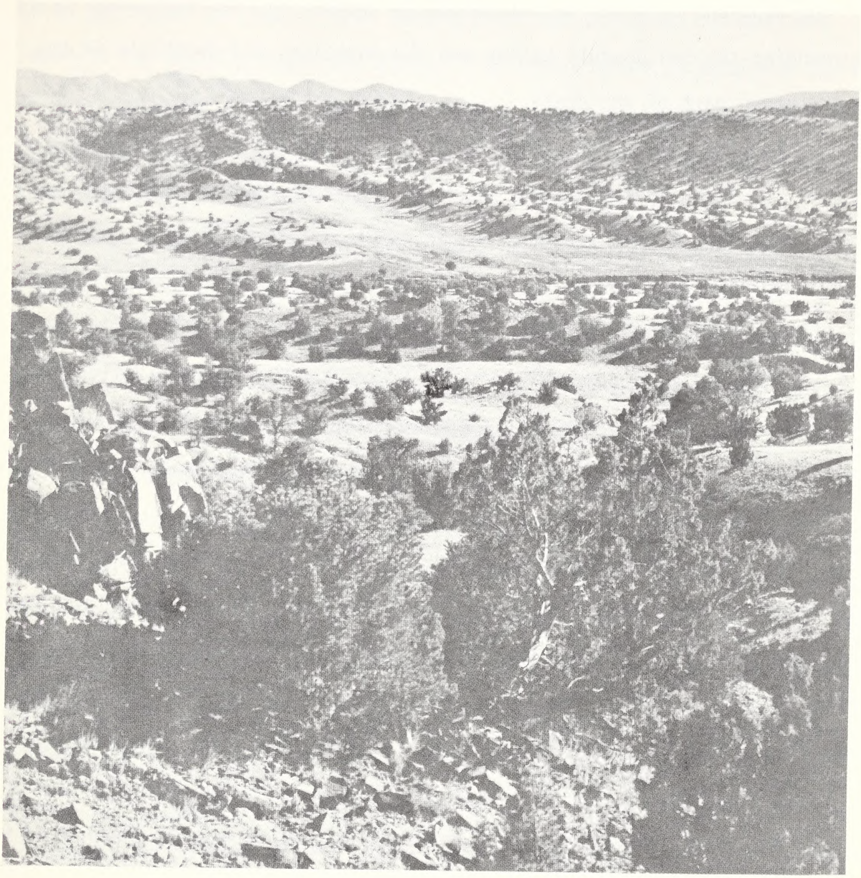


Figure II-23. The pinon-juniper community

graphy of the desert biome applies to much of the woodland-bushland biome.

The woodland-bushland in California is located in the foothills surrounding the San Joaquin Valley and the mountains and foothills of the southwestern part of the state.

Soils

Soils in most of the woodland-bushlands have a slightly higher organic content, are more stable, and are less susceptible to erosion than most soils in the desert. The description of the soils in the desert biome applies to much of the woodland-bushland biome.

Most of the woodland-bushland soils around the San Joaquin Valley are Aridisols with warm-dry surfaces. The soils in the foothills along the west coast are either Entisols or Mollisols and also have warm, dry surfaces.

Minerals

Coal occurs in parts of eastern Utah, Colorado and New Mexico. Vast deposits of uranium also occur in these areas. Oil and gas fields are common in the four corners area of Colorado, Utah, Arizona, and New Mexico. Other oil and gas fields are scattered throughout the biome. The famous mother-lode country of California is in the bushland region of the biome.

Water

Water resources vary considerably from one area to another in the woodland-bushland biome. Most of the surface water is supplied by rivers and streams with headwaters in the forests above the woodland-bushlands.

The woodland-bushland areas generally receive from 12 to 25 inches of mean annual precipitation; however, the California oak-chaparral receives up to 50 inches per year. Both intermittent and perennial streams are found in the woodland-bushland areas. The intermittent streams are particularly common in juniper woodlands. Flood waters of intermittent streams generally carry considerable silt. High-intensity summer thunderstorms are typical of the juniper areas and flood runoffs are common.

Where annual precipitation averages from 10 to 15 inches per year, annual runoff ranges from 0.1 to 5.0 inches per year. Where an average of 15 to 25 inches of precipitation falls per year, annual runoff may range from 0.5 to more than 10 inches. In the California oak-chaparral area, average runoff may be as high as 20 inches.

The quality of most surface waters within the woodland-bushland areas is generally acceptable for most uses. However, some streams in juniper areas have a high silt content. Average dissolved-solids content in surface waters ranges from less than 100 ppm to more than 1,800 ppm. Average sediment concentration of streamflow varies from less than 280 ppm in the oak woodlands to more than 30,000 ppm in some of the juniper associate areas.

Climate

Climate conditions vary significantly within the woodland-bushland biome. The woodlands east of the Sierra Nevada range are comparatively dry because of the mountains' rain-shadow effect; woodlands in the California foothills are influenced by moisture-laden marine air.

In the woodlands on the foothills above the cold desert, about 75 percent of the annual precipitation falls during the winter. In the woodlands above the hot desert, the precipitation is somewhat even throughout the year; the months of July and August bring the most rain. The average annual precipitation ranges from 10 to 20 inches.

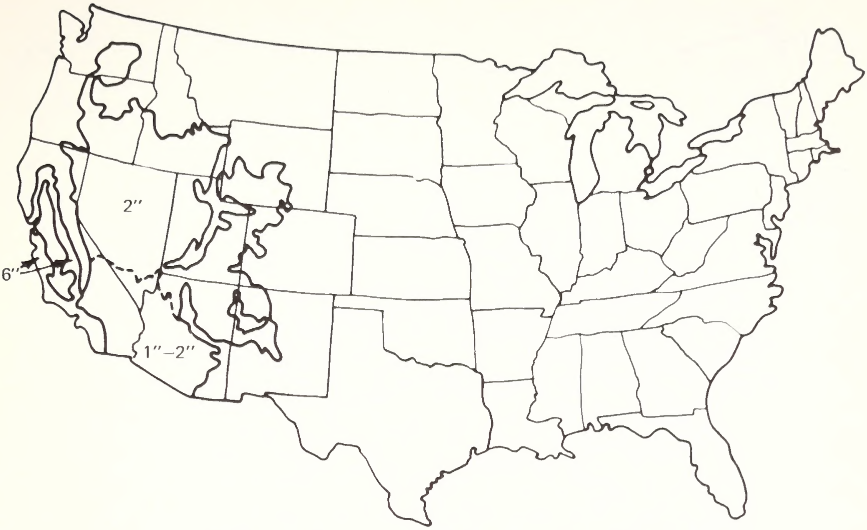
Temperatures range from 20 degrees F below zero to 100 degrees F above; the mean daily temperatures vary from 20 degrees F in January to 85 degrees F in July (Figure II-25).

Windiness, especially in the spring, is characteristic of the woodlands in the desert foothills. Dust devils frequently accompany thunderstorms on hot days (Figure II-26). Winds of 40 mph are not uncommon. Fogs usually occur only in small basins.

Winter storms bring most of the precipitation to the woodland-bushland lands in the California foothills (Figure II-24). The months of June, July, August, and September are dry. Average precipitation ranges from 20 to 40 inches in the north and from 10 to 20 inches in the south.

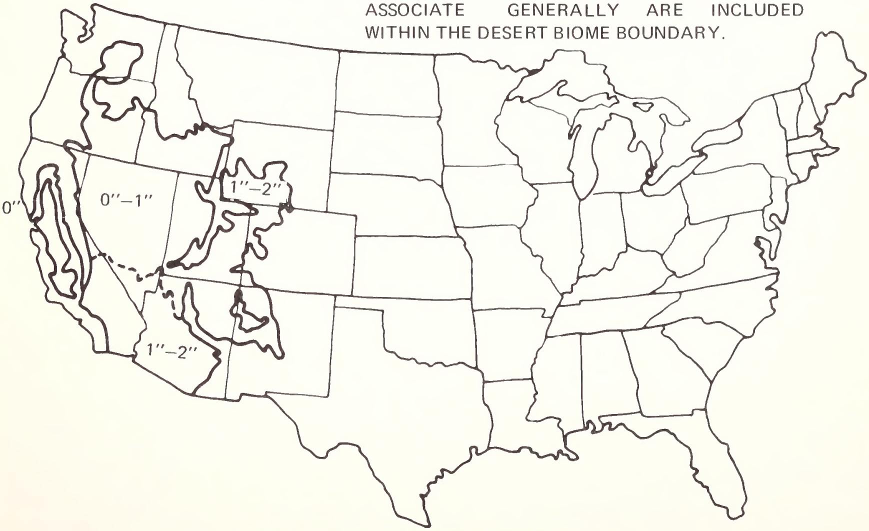
Temperatures in the California foothills range from 5 degrees F to 112 degrees F; mean daily temperatures range from 45 degrees F in January to 70 degrees F in July (Figure II-25). Winds generally are light and from the south during the winter except during the passage of storms, when winds frequently exceed 80 mph. During the summer, winds are out of the northwest at about five mph.

Fog occurs only during the winter in the woodlands in the California foothills and only in small valleys where air becomes trapped by topography. Thunderstorms occur about five days out of the year (Figure II-26), generally in the late spring or early fall.



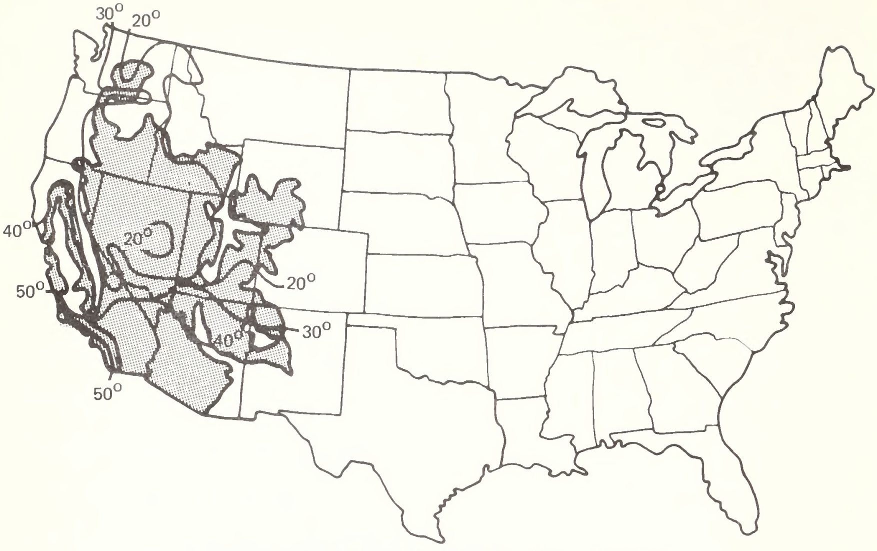
MONTHLY PRECIPITATION (INCHES)–JANUARY

THE OAK WOODLAND–BUSHLAND AND JUNIPER ASSOCIATE GENERALLY ARE INCLUDED WITHIN THE DESERT BIOME BOUNDARY.

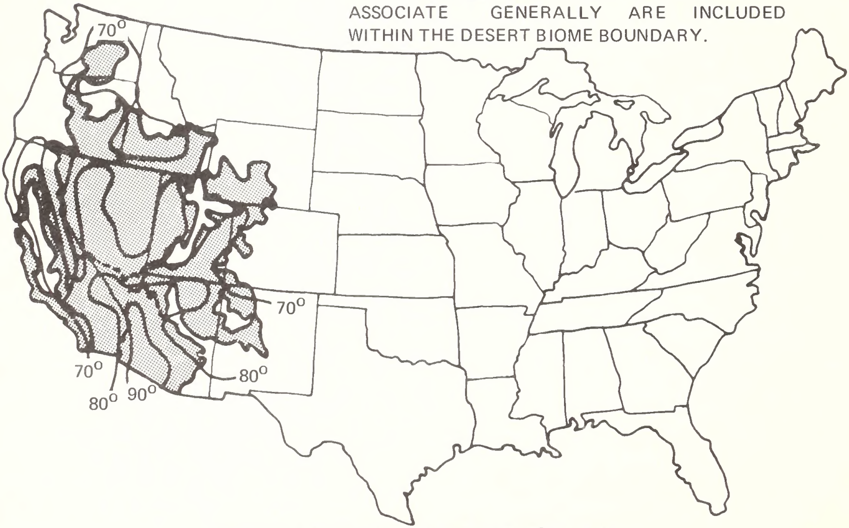


MONTHLY PRECIPITATION (INCHES)–JULY

Figure II-24. Average January and July precipitation in woodland-bushland communities



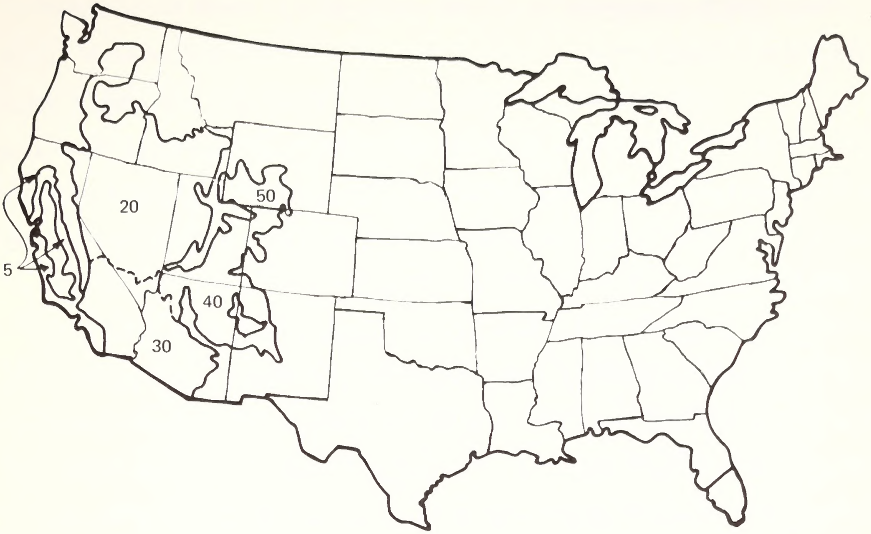
AVERAGE DAILY TEMPERATURE (0°F)—JANUARY



THE OAK WOODLAND—BUSHLAND AND JUNIPER ASSOCIATE GENERALLY ARE INCLUDED WITHIN THE DESERT BIOME BOUNDARY.

AVERAGE DAILY TEMPERATURE (0°F)—JULY

Figure II-25. Average daily temperatures in woodland-bushland communities in January and July



THE OAK WOODLAND—BUSHLAND AND JUNIPER ASSOCIATE GENERALLY ARE INCLUDED WITHIN THE DESERT BIOME BOUNDARY.

Figure II-26. Average annual number of days with thunderstorms in woodland-bushland communities.

Living Components

Vegetation

The woodland ecosystems are still in a transition stage. Woodland communities, particularly junipers, have extended themselves into former grassland and sagebrush sites. This trend is expected to continue until land uses are modified to come into balance with climatic, site, and environmental factors.

Fire is an integral part of the woodland ecosystem. Under natural conditions, fire probably was the major factor in maintaining a balance between the woodland and adjacent plant communities. Modern fire control has contributed to the expansion of sclerophyll and pinon-juniper woodlands into grass and brush types. Changing land uses also have allowed woodland communities to expand.

The woodland-bushland biome is comprised of three broad communities; the broad sclerophyll (oak-chaparral); oak woodland-bushland; and pinon-juniper.

The broad sclerophyll (oak-chaparral) community is best developed on the coastal ranges of southern California, but its range extends from southwestern Oregon southward through California's coastal mountains and the Sierra Nevada foothills into lower California. The vegetation generally consists of trees or shrubs with hard, thick evergreen leaves. The sclerophyll forest, woodland, and chaparral life-forms merge with one another without forming distinct regions and with little or no plant succession relationship.

Chaparral is found in alternating patches in most parts of the community and occupies the greatest area. In California, some five to six million acres of hillsides and canyons are covered with chaparral (2).

The sclerophyll forest generally occurs on north slopes. Scattered trees or woodland types occur with an understory of grass, chaparral, or sagebrush.

A woodland-grass type surrounds the California prairie, extends northeast along the Coast Range, and occurs in other scattered areas.

The chaparral consists of shrubs which form dense canopy thickets with little or no understory vegetation. It occurs on steep, loosely consolidated, highly erodable slopes.

The oak woodland and oak bushland communities are scattered and generally occur as ecotones between the desert biome and the pinon-juniper community. The oak bushland community is found in the Rocky Mountain foothills and the interior mountain ranges in Utah and Arizona at elevations between 5,000 and 8,000 feet. The vegetation usually does not form a continuous cover, but occurs instead in dense clumps (2). In addition to oak, the vegetation generally consists of many species of deciduous shrubs. The composition of the shrubs is dependent upon elevation, topography, and aspect. "The number of plant dominants is large with several species appearing regularly in each community" (3, p. 295).

The oak woodland community occurs in southern Arizona and New Mexico. Oak, juniper, small trees, undershrubs, and grasses are interspersed in the community. Understory vegetation ranges from cacti and yucca to grasses and shrubs. Topography usually is steep to rolling and soils generally are erosive.

The pinon-juniper communities cover an area of approximately 60 million acres interspersed through the cold desert. A majority of the type occurs in Nevada, Utah, Colorado, Arizona, and New Mexico.

Pinon-juniper generally occurs at elevations between 5,000 and 7,000 feet. Stand density varies from a very few trees per acre to 600 or more per acre. An open stand is typical, but dense stands are not uncommon. Stands often thicken progressively from scattered trees at lower elevations to maximum densities just before the vegetation changes to timber or mountain shrub types. The lower, sparse stands are frequently developed on sagebrush or desert grass sites. Since junipers are more drought resistant, they are commonly found at elevations 500 feet lower than pinon. Broad areas with savannah characteristics occur in New Mexico and Arizona; the understory is comprised of mixed desert grasses and shrubs.

The herbaceous undercover varies inversely with the tree and shrub density. However, studies in Arizona indicated that shrubs may increase with the number of trees until a tree density of 50 percent is reached.

The shrub undercover decreases sharply where tree canopy exceeds 60 percent ground cover (55).

Animals (1,42,43,56)

Terrestrial Wildlife

Few animals are restricted to the pinon-juniper woodland. Birds such as the pinon jay and the gray flycatcher are characteristic species of this biome. Juncos are general inhabitants during the winter months. In the Kaibab-Zion area, the mule deer is dominant. The mountain lion, coyote, and bobcat are the principal predators. The desert wood rat and the rock ground squirrel are characteristic residents. The nocturnal pinon mouse is perhaps the most abundant mammal found throughout the woodland. The cliff chipmunk, black-tailed jackrabbit, and Nuttall's cottontail are of common occurrence. Nesting birds include the golden eagle, red-tailed hawk, and scrub jay.

The number of reptiles in the pinon-juniper is limited; they are most common at lowest elevations. Reptiles include the sagebrush swift, several lizards, and the rattlesnake and kingsnake.

More mammals occur in the oak woodland of southern Arizona and New Mexico than in the pinon-juniper type. They include the ring-tail, white-tailed deer, mule deer, peccary, coatimundi, scaled quail, Mearns quail, fox squirrel, turkey, and mourning dove. Forty-two permanent resident birds, at least 16 species of lizards, and as many snakes have been listed.

In the oak bushland, mule deer and coyotes are prominent. The long-tailed weasel and spotted and striped skunks are common. Hibernating mammals include the jumping mouse, marmot, and Uinta and golden-mantled ground squirrels. Robins, jays, and chickadees are common. Large, mixed flocks of birds winter in canyon bottoms or other sheltered locations. Of 11 reptiles in the community, only the rubber boa appears to belong primarily to the bushland.

Several subspecies of mule deer range throughout the broad sclerophyll community. Typical mammals include the mountain lion, bobcat, coyote, gray fox, wood rat, skunk, and brush rabbit. The Merriam chipmunk, California mouse, and five-toed kangaroo rat are confined to chaparral. Many small birds and lizards live in the community, and amphibians include the tree frog and certain salamanders.

Aquatic Wildlife

Aquatic wildlife forms are characterized by cold and warm water fish species. A variety of aquatic environments exist in small, sometimes intermittent streams, upper reaches of larger rivers, impoundments, and some natural lakes,

Waters are moderately rich in nutrients and microorganisms; water quality may be fair to good. Some streams may carry heavy silt at times in brushland areas; the better quality and more stable waters are located in wooded areas.

Representative fish are trout, whitefish, catfish, suckers, carp, squawfish, shiners, minnows, dace, chubs, sculpins, sunfish, perches, basses and pikes.

Threatened Wildlife (42)

There are no known threatened species of mammal, bird, or fish unique to this biome. Some threatened species range into it, including the spotted bat, Utah prairie dog, San Joaquin kit fox, blunt-nosed leopard lizard, Colorado squawfish, and the humpback chub.

Domestic Livestock

Livestock distribution and use in the woodland-bushland biome is similar to that in the desert biome. The pinon-juniper type serves as spring and fall range for both sheep and cattle and as summer range for cattle only in some areas. Some winter sheep grazing occurs in the southern half as well as some year-long cattle grazing. Horse grazing is minor, although portions of some wild horse areas are located in this biome.

Most of the forage species in the broad sclerophyll community are winter annuals. Therefore, most grazing occurs during the winter and early spring.

The number of cattle in the biome has been increasing and the number of sheep has been declining for several years. The number of domestic horses has leveled off after declining sharply.

Most ranches are cow-calf operations. Sheep ranches place emphasis on grass-fat lambs. In the broad sclerophyll community, many cattle ranches run steers or yearlings because of the seasonal nature of the forage.

Wild Horses and Burros

The range of wild horses throughout the desert biome includes associated habitat inside the pinon-juniper regions of the woodland-bushland biome. Those horses restricted to rugged inaccessible areas of pinon-juniper are seldom observed by humans. Burro populations occur only in small isolated numbers in remote sectors of the biome. Official reports show barely 100 head of wild burros throughout the biome.

Human

The population and economic aspects of this biome are dominated by the California coastal range, from San Francisco to San Diego. Over 46 percent of the total population of the 11 western states reside in this region mostly in urbanized areas. Population density of the central coastal area averages 310 persons per square mile, while the southern coastal area averages 762 persons per square mile. Incomes are relatively high, 12 percent above the western average, and the percentage of families below poverty levels is lower.

Only one or two percent of total employment is engaged in agriculture. The livestock-related economy is minimal. The region is estimated to import more than four times the amount of livestock produced within the region.

Ecological Interrelationships

Except for the California chaparral-bushland--a fairly contiguous community--the woodland-bushland communities occur principally as an ecotone between the desert or grassland biomes and the forest biome. The ecological interrelationships of the woodland-bushlands are closely related to those of the adjacent biomes.

Most of the vegetation is trees or shrubs. Storage of nutrients in the woody plants slows the nutrient cycle. Usable nitrogen is believed to be a limiting factor in productivity.

The woodland-bushland community often occurs on unstable soils and physiographic features. Disturbance of the vegetation often results in extensive erosion and subsequent establishment of desert-type communities, even at higher elevations.

The aquatic ecosystem in the woodland-bushland biome occurs primarily in perennial and intermittent streams generally originating in higher elevations. High intensity storms are common in the biome and result in heavy downstream siltation. Surface disturbance accelerates siltation. Information on the aquatic ecosystem and the microbial ecology of the woodland-bushland is limited and needs further study.

The California chaparral can be considered as an example of a subclimax vegetation resulting from the continuing influence of fire. The vegetative composition and hot dry summers present a recurring and extreme hazard. Fire removes the shrubby vegetation, the herbaceous vegetation develops rapidly and occupies the site until shrub dominance is reestablished. Removal of the heavily dominant shrub ecosystem by fire or other means can result in disastrous floods and extensive siltation.

Land Uses

Rough and steep topography limit agriculture activities in most areas to livestock grazing. Minor portions of the biome are irrigated.

Big game and upland game birds provide hunting opportunities in most parts of the biome. Areas near cities and towns are used extensively for outdoor recreation; recreation use probably will increase in the future.

Many areas in the biome, such as the California "mother-lode" country, were mined extensively for minerals over a hundred years ago. Most of the mining in that area is now restricted to individual part-time efforts. Underground mining of coal occurs in Utah and Colorado. Open-pit coal mining is increasing. Uranium is mined underground. Areas in Colorado, Utah, and New Mexico produce oil and gas and the potential for discovery of additional production areas appears to be relatively high. The western side of the San Joaquin Valley of California also has oil and gas bearing formations and a number of producing wells. The pilot production of petroleum from oil shale is just getting underway in Colorado. Potentially land uses could be altered drastically on oil shale areas of Colorado, Utah, and Wyoming if commercial production occurs.

The biome contains extensive roadless or undeveloped areas with primitive qualities. Some streams in these areas may meet criteria for wild rivers;

a number are now under study. The California oak-chaparral tends to be more developed and has fewer areas with primitive or semiprimitive qualities.

Woodlands in the biome provide a small, but locally important, source of cordwood and fence posts. Pinon-pine nuts are harvested by Indians and others.

Small, isolated ranching or mining towns are scattered throughout the area. Suburban expansion is occurring in the biome in California and in the Salt Lake City area.

Hazards

Hazards in the woodland-bushland biome are similar to those in the cold desert. The broad sclerophyll community presents a major fire hazard to suburban developments in California.

Aesthetics

The woodland-bushland visual environment is one that varies greatly. It ranges froma semiarid to a wooded foothills landscape.

Since valley bottoms in the West are also principal travel routes, much of the woodland-bushland type is exposed to view of the traveling public. In some areas, this view is from a considerable distance. In others, it is directly adjacent to the travel route.

Land form of the woodland-bushland communities varies from relatively flat valley bottoms through the low-rolling foothills to deep-cut canyons and high mesas. Most typical of these would be the rolling foothill area.

Texture varies as the density of the stands vary, from a continuous dense canopy to an open, scattered random pattern.

Color varies almost as much as land form and texture. Where there is a fairly continuous canopy, the gray-green of the vegetation is predominant. As the stands thin, color of the soil or rocks becomes dominant.

Lines are evident only where there is an abrupt change in the vegetation type or where there has been some disruption of the vegetation, i.e., roads, powerlines, chaining, etc. Scale is more easily defined and much more obvious in the woodlands than in the grasslands or desert.

Human Interest Values

Geological

Most geological features of interest are similar to those found at similar elevations in the surrounding desert or grassland areas which have been previously discussed. For example, the woodland-bushlands may cover the tops of high mesas which are an integral part of the dramatically eroded areas on their flanks. In the California foothill woodland areas, there are numerous faults. Large faults, such as the San Andreas fault passing through both prairie and woodlands, exhibit visible displacement.

Archeological

Prehistoric peoples who used the juniper associate and oak woodlands were, for the most part, the same types who inhabited the hot and cold desert. Different activities tended to take place in the woodland-bushland biome such as hunting or gathering of wild nuts and seeds, but one also finds agricultural areas cleared in the juniper areas so there is no clearcut division of usage.

In the broad sclerophyll areas of southern Oregon and California are indications of the same prehistoric peoples as in the California and Palouse prairie grasslands---an Old Cordilleran Tradition base that developed into an Archaic Tradition which continued to current times.

Historical

Historically, the woodland-bushlands were probably among the last areas to be settled because of the difficulty of converting them to agriculture. Heavy brush and the lack of water made the biome less valuable for agriculture, and grazing was the predominant use in most cases. Consequently, most of the historic events that took place in the woodland-bushland tended to be associated with livestock trailing and Indian wars, rather than settlement oriented.

The broad sclerophyll community in California includes the "mother-lode" country of the 1849 gold rush. The area is replete with old ghost towns, and remains of mining activities such as dredge piles and huge hydraulic cut banks.

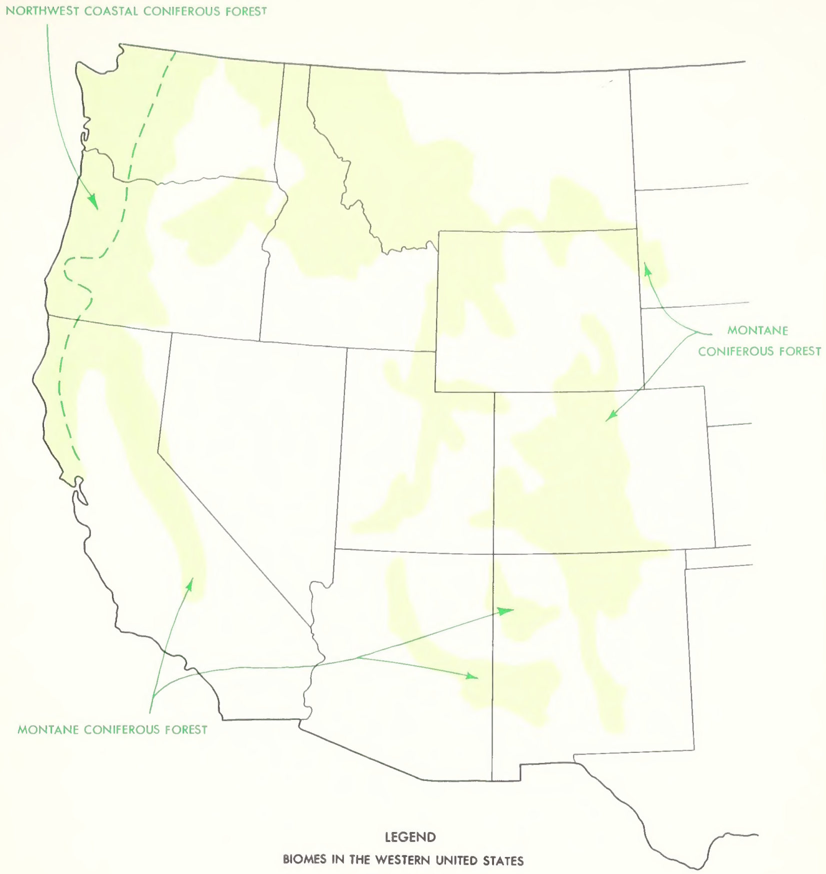
Cultural

This biome has similar cultural values to those of the desert. Of more unique significance, brushlands and wooded foothills of the southwestern portion of the California Central Valley lie along the route of the Spanish Roman Catholic missionaries of the 18th century. Many missions have been restored along El Camino Real, while other sites remain as interesting ruins of more historical than cultural or religious significance.

Coniferous Forest Biome

The coniferous forest biome in the western United States consists of two well defined forest communities (Figure II-27).

The montane coniferous forest (and alpine communities) covers the Cascade Mountains in Washington and Oregon, and the Siskiyou Mountains in


NORTHWEST COASTAL CONIFEROUS FOREST
MONTANE CONIFEROUS FOREST
MONTANE CONIFEROUS FOREST

LEGEND

BIOMES IN THE WESTERN UNITED STATES

I. GRASSLAND BIOME
  1 Temperate Grassland
  2 Palouse Prairie Grassland
  3 California Prairie Grassland

II. DESERT BIOME
  1 Cold Desert
  2 Hot Desert

III. WOODLAND-BUSHLAND BIOME
  1 Broad Sclerophyll
  2 Oak Woodland-Bushland*
  3 Juniper Associates*

IV CONIFEROUS BIOME
  1 Northwest Coastal Forest 🟩
  2 Montane Forest 🟩

(*Generally included within the desert biome boundary.)

FIGURE II-27 CONIFEROUS BIOME IN THE WESTERN UNITED STATES.

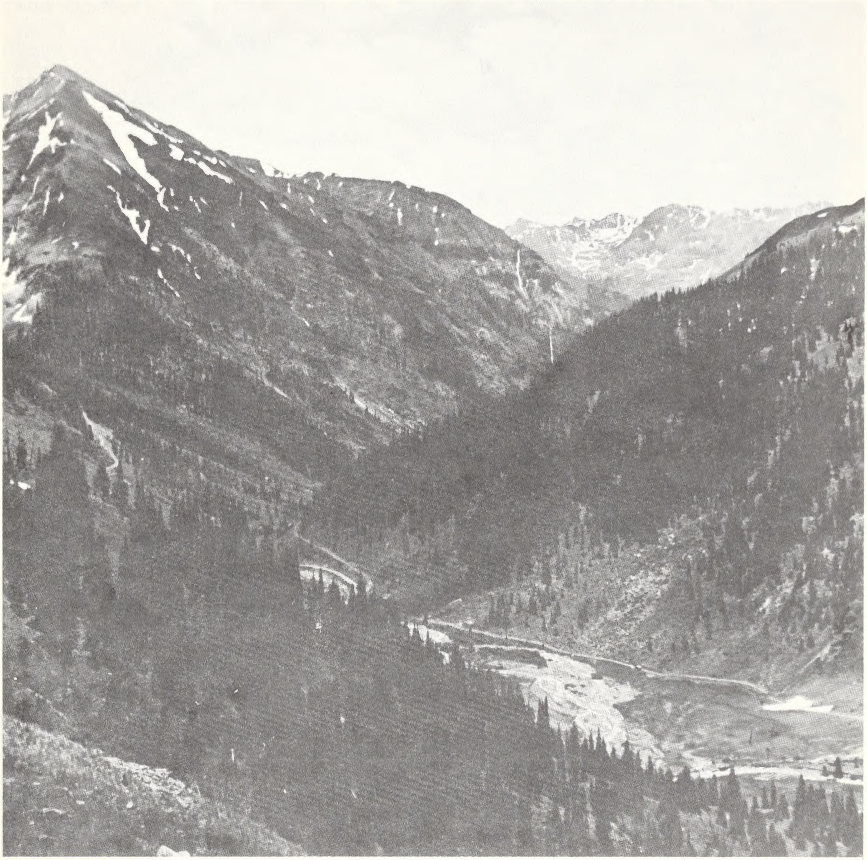


Figure II-28. The montane coniferous forest

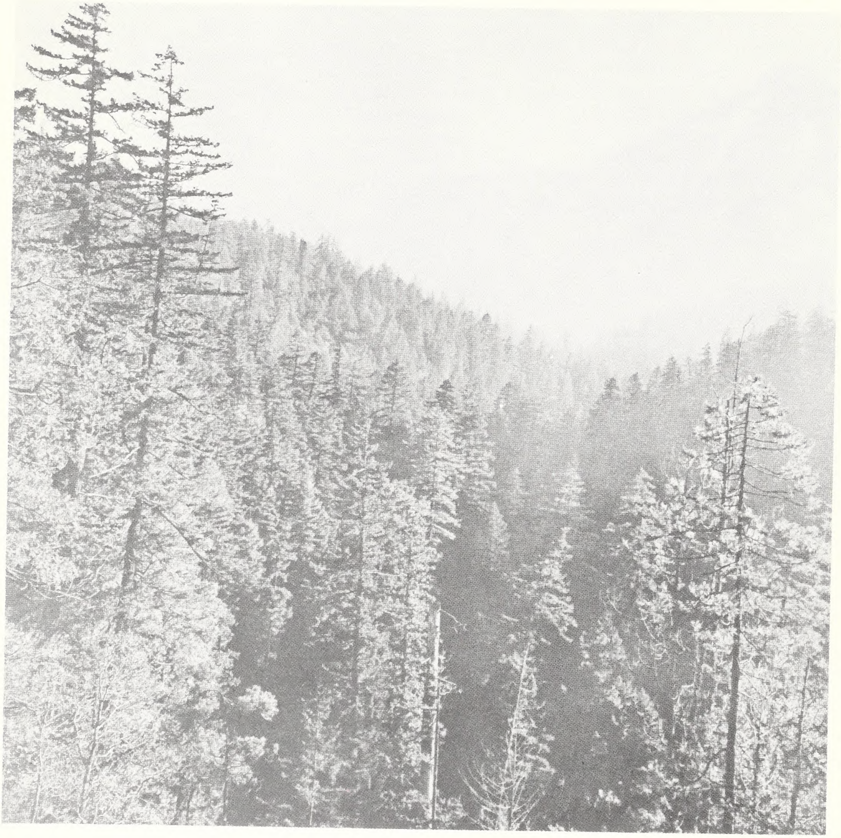


Figure II-29. The northwest coastal coniferous forest

Oregon, and the inner Coast Range and Sierra Nevada in northern California from woodland transition to timberline. They extend eastward to the woodland types of the Great Basin and across the Rocky Mountains to the grasslands of the Great Plains.

The northwest coastal forest, the most dense coniferous forest type, is a rain forest. It extends along the Pacific Coast from southern Alaska to western Washington, western Oregon, and northwestern California. Figures II-28 and 29 illustrate the two coniferous forest types in the West.

The extent of federally owned lands and mineral rights in the coniferous forest biome is relatively high, especially in the montane regions.

Non-Living Components

Topography

The Cascade and Siskiyou Mountains, Coast Range, and Sierra Nevada are moderately to steeply sloping with relief from base to peak varying from 1,000 feet to over 3,000 feet. On the Columbia plateau, the topography is moderate to gentle. In the northern Rockies and most of the southern Rockies, the mountains are moderately to steeply sloping with relief in some areas exceeding 3,000 feet.

Soils

Soils in the coniferous forest biome range from the Inceptisols in cold wet climates to the Mollisols in warm dry climates.

Inceptisols and Ultisols generally occur in the higher elevations and in areas receiving considerable precipitation. Ultisols have clay-enriched subsoils, and are acid in nature. Characteristics of the Inceptisols vary greatly. Inceptisols and Ultisols occur in northeastern California, western

Oregon and Washington, and from the Canadian border in northern Idaho and northwestern Montana to central Idaho. A few areas of Spodosols are intermingled with the Inceptisols and Ultisols.

Alfisols occur in areas receiving less rainfall than areas in which Ultisols have formed and therefore are more basic in nature than the latter. Alfisols have a clay-enriched subsoil and a gray to brown surface soil. Large areas of Alfisols are located on the east and west sides of the Sacramento Valley in California and on the east front of the Rocky Mountains in Montana, Wyoming, and Colorado.

Mollisols are basic soils which are organically rich and dark colored. Mollisols are located in the southern Rocky Mountains in Utah and Arizona.

Entisols are young soils lacking distinctive subsoil horizons. They occur on recent deposits of alluvium, on very steep areas having soil creep, and on recently stabilized sand dunes. These soils occur in western Colorado, northwestern New Mexico, and central Utah.

Aridisols are generally associated with the desert. However, Aridisols support coniferous forests in parts of New Mexico and Arizona.

Minerals

Mining, mineral processing, and refining have significantly affected the human environment in and near local communities such as Butte, Anaconda, and East Helena, Montana; Mullan, Kellogg, Wallace, and Pocatello, Idaho; Park City and Price, Utah; Aspen, Leadville, Silverton, and Climax, Colorado; Lead, South Dakota; and Questa, New Mexico. Copper, coal, gold, silver, lead, zinc, molybdenum and phosphate are the principal products. In the early history of mining in these and many other unnamed localities, mining was generally carried on by underground methods, whereas today in some of the above localities, mining is being done by open-pit methods. These changes have aggravated waste and tailings disposal problems.

Water

The water resources of the coniferous forests provide for most of the water needs of the western United States. Major rivers and streams flow from the forests into the grassland, desert, and woodland-bushland biomes. Most streams of the coniferous forests are perennial, although some may be intermittent in regions where extended dry periods occur. Natural lakes are an important part of the surface water resource of the coniferous forest biome.

Average annual runoff from the coniferous forests ranges from about five inches in the southern Rocky Mountains to more than 150 inches in parts of northwest Washington. In the lower coastal mountains of northern California, Oregon, and Washington, where precipitation occurs during the winter predominantly as rainfall, most of the runoff occurs from November through March.

The quality of most surface waters in the coniferous forests is good to excellent. Average dissolved-solids content generally is less than 100 ppm. The suspended-sediment concentrations in coniferous forest streams are generally less than 280 ppm.

Climate

Moist Pacific air moving in a west to east path results in extremely high rainfall in mountain ranges along the northwest coast from Washington to California. After the dry season reaches its climax in July and August, the rainy season comes on gradually and reaches its peak in December (Figure II-30). Average annual precipitation ranges from 30 to 40 inches in the San Francisco area and 60 to 140 inches in the Olympic Mountains of Washington.

Temperatures range from a low of 0 degrees F along the Washington coast to 30 degrees F at San Francisco; high temperatures can reach into the 90's throughout the area. Mean daily temperatures range from 20 degrees F to 35 degrees F in January to 50 degrees F to 70 degrees F during July (Figure II-31).

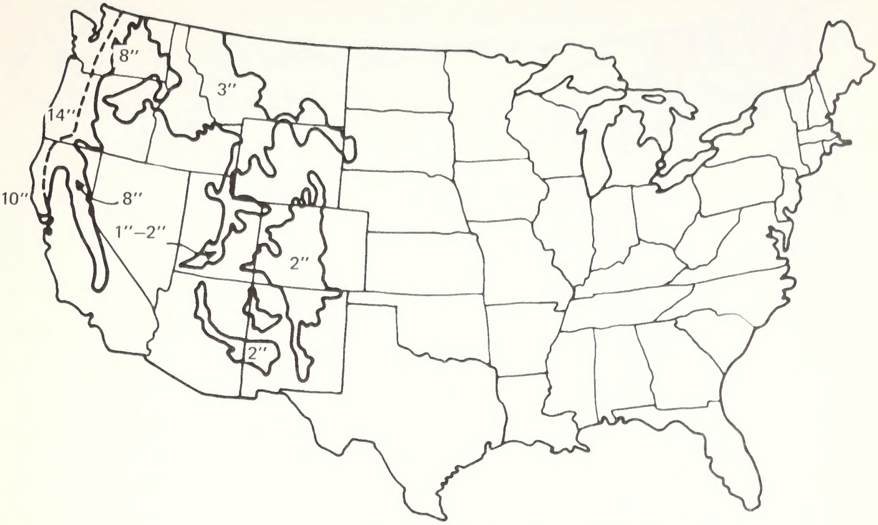
During the winter, the wind sometimes attains hurricane force along the ocean coast. Northerly winds prevail--in summer months--especially in the daytime. Thunderstorms are infrequent and usually weak along the western part of the area (Figure II-32).

The climate of the montane coniferous forest is directly related to elevation--the higher the elevation, the colder and wetter the climate.

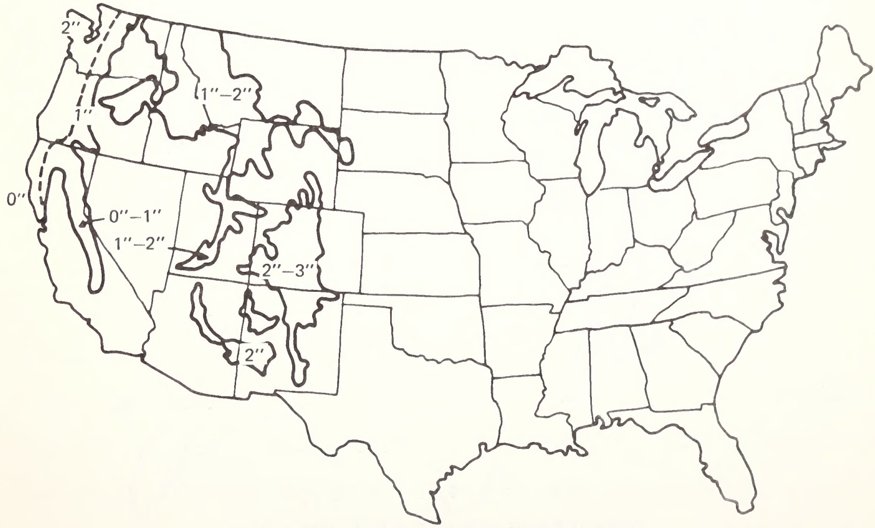
Precipitation at the lower levels generally averages about 20 inches a year. The higher elevation Sierra Nevada receives 50 inches, the Cascades 90 inches, and the Rockies 30 inches. Average January precipitation varies from eight inches along the Sierras and Cascades to one to three inches in the Rockies.

Average July precipitation ranges from one inch or less along the Sierra Nevada and Cascades to two or three inches in the Rockies.

Average daily minimum temperatures during January range from 20 degrees F at the lower elevations to 0 degrees F at the higher elevations. Maximum temperatures during July average 85 degrees F at lower elevations to 70

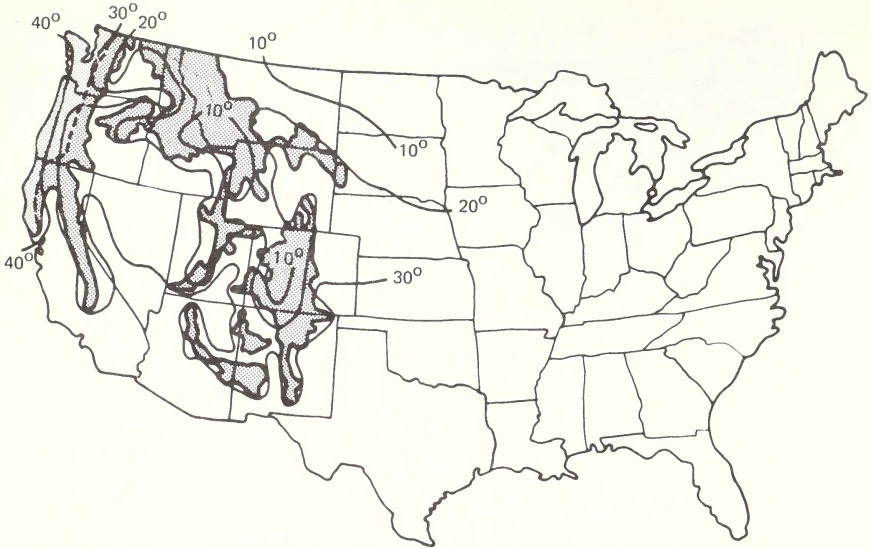


MONTHLY PRECIPITATION (INCHES)—JANUARY

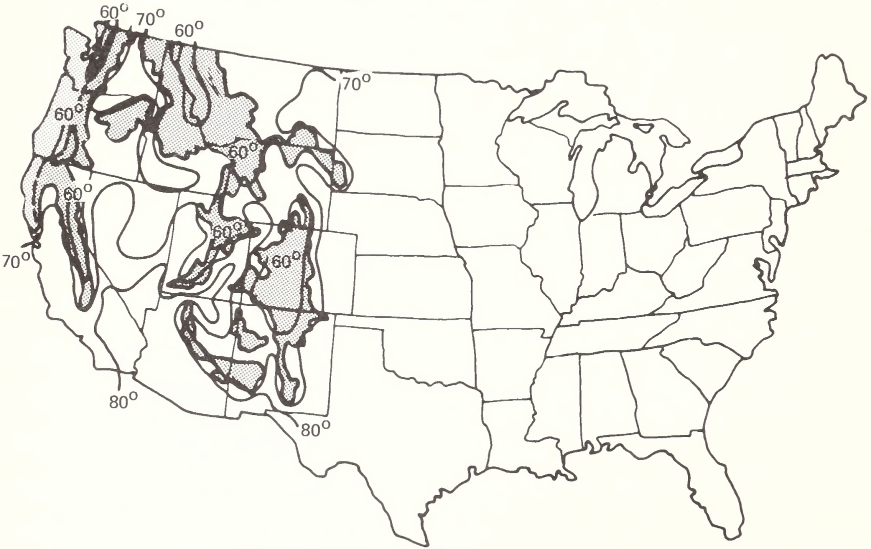


MONTHLY PRECIPITATION (INCHES)—JULY

Figure II-30
Average January and July precipitation in the coniferous forest biome—conterminous United States



AVERAGE DAILY TEMPERATURES (0°F)—JANUARY



AVERAGE DAILY TEMPERATURES (0°F)—JULY

Figure II-31.
Average daily temperatures in the coniferous forest biome in January and July—conterminous United States

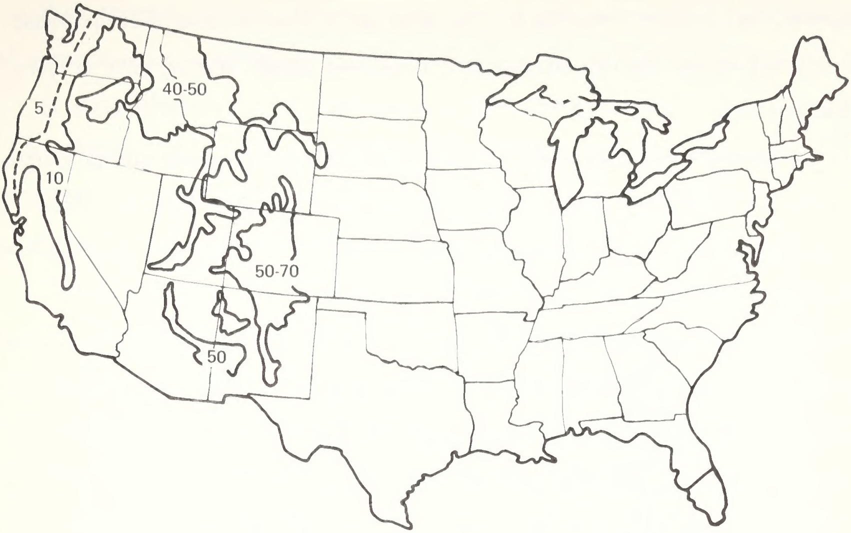


Figure II-32 Average annual number of days with thunderstorms in the coniferous forest biome — conterminous United States

degrees F at higher elevations. The mean daily temperatures average about 10 degrees warmer during January and 10 degrees colder during July (Figure II-31).

Topography and convective activity--especially during the summer months--affect wind directions and velocities. At the mountain summits, winds generally are from the west and are frequently very strong in the winter and spring.

Thunderstorms occur frequently in the montane coniferous forest. There are an average of 50 to 70 in the forested areas of Colorado and New Mexico each year (Figure II-32).

Living Components

Vegetation

The identifying lifeform in this biome is the needle-leaved coniferous evergreen tree, especially the spruces, firs, and pines. The evergreens form a relatively continuous canopy over the forest floor. The dense, year-round shade often results in poor development of shrub and herb layers. Productivity varies from the fast growing forests of the Pacific Northwest to the slow growing arid portions of the montane coniferous forests.

The composition of the forest vegetation is influenced to a large extent by elevation. Elevational differences lead to the development of four basic vegetational zones in many mountainous areas. Proceeding upward from the lowlands, the zones are the woodlands, forest, subalpine forest, and alpine meadows.

Many forests contain numerous water bodies and courses and a variety of aquatic plant species.

Natural forces such as bark beetles, defoliating insects, disease, and fire kill unusually high numbers of trees in some years. However, the outbreaks are part of a continuous cycle to which the coniferous forest ecosystem is adapted through rapid plant establishment and succession.

Timber has been, and is being, harvested in much of the biome. However, many sections of the coniferous forest are still in their natural state. The forest vegetation provides aesthetic and recreational values and protects extensive watersheds by stabilizing the soil. The vegetation also provides shelter, protection, and food for the many forms of wildlife.

Predominant tree species vary among the basic forest types in the coniferous forest.

Primary species in the lower elevations of the montane forest are Douglas-fir, Engelmann spruce, ponderosa pine, lodgepole pine, and aspen. Subalpine and alpine areas in the higher elevations have dense interspersed stands of subalpine firs and Engelmann spruce. In addition to being an important timber producing region, the montane forest includes large areas administered for recreation and wilderness uses.

The northwest coastal forest is characterized by lush vegetation. Douglas-fir, redwood, hemlock, western red cedar, and sitka spruce are the predominant tree species. A dense vegetal understory is made up primarily of mosses, salal, and salmonberry. This forest constitutes one of the most productive timber growing regions in the world.

Animals

Terrestrial Wildlife (41)

The coniferous forest biome includes caribou, moose, mountain goat, white-tailed deer, grizzly bear, black bear, mountain sheep, spruce grouse, blue grouse, and ruffed grouse. Elk and mule deer occupy openings and seral stages of the forest during the summer, and move down to adjacent lower elevation biomes for the winter. Mountain lions and coyotes are also common. Smaller animals of the montane forest include the porcupine, snowshoe rabbit, long-tailed weasel, striped skunk, flying squirrel, red squirrel, pocket gopher, deer mouse, western jumping mouse, and vagrant shrews. Fifty-six species of nesting birds have been recorded in the central Rocky Mountains. To the south, the Kaibab and Aberts squirrel occur. In the Oregon-California portion of the montane forest, mountain quail, band-tail pigeon, Oregon junco, pygmy owl, and the California mountain kingsnake are common. A number of destructive insects (spruce budworm, Douglas-fir beetle, mountain june beetle, and Jeffrey pine beetle) feed on the trees.

Some of the same species of animals found in the central Rocky Mountains are found also in the northwest coastal forest. Principal mammals are related to Rocky Mountain species. Roosevelt elk and black-tailed deer are characteristic of this forest, as is the smaller mountain beaver. Douglas gray squirrel, coast mole, and band-tailed pigeon are typical residents.

Aquatic Wildlife (41)

The waters in most of the streams and rivers in the montane coniferous forest biome are usually of high quality and low temperatures.

Aquatic ecosystems are diverse and complex. They usually contain a fair grade of aquatic food. High elevation streams support trout, whitefish, and sculpin. Lower streams support chub, carp, dace, suckers, and salmonids. Other common fish in the biome are black bass, sunfish, catfish, pike, and minnows.

West Coast streams produce anadromous steelhead and five commercially important species of salmon: the chinook, sockeye, chum, pink, and coho. Migratory populations of coastal cutthroat trout are present in many coastal streams from California to Bristol Bay, Alaska. The anadromous fisheries are unique and directly dependent on the forest watershed.

Inland waters of the coniferous biome that do not empty directly into the sea are characterized by high quality, low temperatures, and a fair grade of aquatic food.

Threatened Wildlife (42)

Following species are possibly endangered, but there is insufficient evidence to determine their status at this time: the pine marten, fisher, wolverine, and Canada lynx. Threatened species include: Grizzly bear, Columbia white-tailed deer, Kaibab squirrel, Arctic grayling, greenback cutthroat trout, and Little Kern golden trout.

Domestic Livestock

Most domestic livestock grazing in the coniferous forest occurs on the mountain meadows interspersed as small vegetative islands throughout the biome and in open forest stands where forage species grow among scattered trees.

Both cattle and sheep graze in the coniferous forests. Most of the cattle graze in the lower elevations and most of the sheep in the higher elevations. The alpine zone is grazed almost exclusively by sheep. Most livestock grazing occurs between June 15 and October 1. Some horses graze in the biome in connection with recreation activities, such as riding and pack trips. Although horse use is generally minor, it tends to concentrate in popular areas.

Over the years, livestock use declined on the coniferous forests as portions were withdrawn from grazing for watershed protection purposes. This trend could continue as demand for water increases in the West.

Wild Horses and Burros

Some bands of wild horses in the desert biome will range into remote areas of the montane coniferous forest as part of their seasonal habitat. Because of the higher elevations in the coniferous biome, adverse winter climatic conditions restrict year-round use of the biome by wild horses except in those mountain areas where exposed south-facing slopes may afford marginal habitat.

Human

About 20 percent of the western states' population resides in this biome, principally in the Pacific Northwest. Population densities vary, as they do in the grassland biome. Unlike the grassland biome, the rural population has increased since 1960 instead of decreased, with the exception of the Idaho mountainous area. Except for the Pacific Northwest and the California portions of this biome, income levels are lower than average and the percent of families below poverty levels is higher, but differences are not as great as in the grassland biome.

The economies of this biome are heavily dependent on primary type industries. In the Pacific Northwest and mountains of California and Idaho, the timber industry dominates the primary sector with agriculture second. In the mountainous areas of Arizona and Colorado, mining is the major primary industry very closely followed by agriculture. In Montana, Utah, and Wyoming, agriculture-principally livestock production--is at least of equal importance with mining and timber. Except for the Pacific Northwest,the percent of employment in agriculture is above the western average, but not nearly as high as in the grassland biome. Income derived from livestock production ranges from a low of two-tenths of one percent of total income in the Pacific Northwest, to about six percent of total income in the Idaho portion of the biome. The NRL supply 1,110,000 cattle AUMs and 250,000 sheep AUMs which represent about six percent of the total livestock feed consumed in the biome.

The Seattle and Portland metropolitan areas are located in a broad valley extending from Puget Sound to central western Oregon. The valley contains the bulk of the intensive agricultural land in the region! Low cost hydro-electric power, abundant water resources, and deep water ports have contributed to industrial growth in these urban areas.

Most communities in the montane coniferous forest are also small and serve the logging, ranching, or mining which may occur in the area. Recreation expenditures also play a significant role in community support throughout this biome.

Ecological Interrelationships

The western coniferous forest communities are characterized by tree species generally providing dense canopy cover and heavy shade. However, woodland-bushland and grassland communities are interspersed through the biome, especially in the montane coniferous forest.

Precipitation in the coniferous forest ecosystem is high, and generally there is adequate moisture for maximum production of the living components. The forest watershed is a primary source of water flowing through biomes at lower elevations.

The heavy shade throughout the year limits development of understory. Moderate amounts of soil organisms occur. A large volume of nutrients is contained in the biomass of large trees. The turnover time in ratio of biomass to production is slow and over-exploitation could reduce productivity by physical removal of the nutrients from the ecosystem.

Coniferous forest ecosystems generally occur on moderate to steep slopes and often on unstable and erodable soils. Physical disturbance of the forest can increase stream temperatures and sediment concentrations and can adversely affect aquatic ecosystems. Aquatic ecosystems in the biome are complex and diverse. Anadromous fisheries are dependent upon the forest watershed, especially in the northwest coastal forest.

Fire is an important ecological factor in the biome, since it can destroy a stabilized habitat by removing the predominant forest cover and result in creating new biological communities. The results of fire are especially important in the northwest coastal coniferous forest, an area of high rainfall, but where an annual dry season in July and August may create critical fire hazards. On the other hand, fire is considered by many forest ecologists as necessary to perpetuate the lodgepole pine type in the montane forest. Favorable climatic conditions generally enhance rehabilitation and natural successional recovery in the northwest coastal and montane forest ecosystems.

Land Use

Forest products, mining, agriculture, and tourism are major sectors in the economy of the montane coniferous forest. Lumbering and livestock grazing occur throughout the biome. Ranches or small farms usually are located along streams or river valleys, Mining--not as extensive as lumbering or grazing--provides significant income and employment in some communities in the forest.

Recreation-tourism activities are growing rapidly in the montane coniferous forest. In areas with outstanding recreation attractions, such as the Yellowstone Park area and Aspen, Colorado, tourism is the mainstay of local communities. The montane coniferous forest contains many of the Nation's most important outdoor recreation resources. A substantial acreage of undeveloped land and designated wilderness is located in the forests.

Although most of the northwest coastal forest is rough and mountainous, it is an extremely significant timber-producing area. Lumbering and wood products industries play a dominant role in income and employment throughout the area.

Forested lands, abundant wildlife and fish resources in the northwest coastal forest provide significant recreation opportunities. The Pacific Ocean adds to the recreational diversity. Long periods of rain or fog limit opportunities for outdoor recreation to some extent.

Hazards

As in the other biomes, many plant communities within the coniferous forest contain plants poisonous to livestock. Since livestock graze on the biome mostly during the summer season, the poisonous effect of preferred plant species (such as larkspur) has usually subsided before the grazing season. Also, individual poisonous plants present in a healthy community do not have an adverse effect on the herbivores because of the variety of diet consumed by the animals.

The susceptibility of forests to wildfire creates a hazard to humans, livestock and wildlife during burning periods.

The severe climatic conditions that prevail during the fall and winter season in the montane coniferous forest presents extreme safety hazards to the novice sportsman pursuing recreational activities such as snowmobiling and hunting.

Aesthetics

Coniferous forests provide perhaps the most spectacular scenic values of all biomes. Landform varies from rounded foothills of the Cascades to angular peaks of the Rockies, from relatively flat mesas and basins to nearly vertical-walled canyons.

Textures vary from the relatively soft continuous forest canopy of the west slopes of the Cascades to the broken patches of trees among rocks at higher elevations of the montane regions. Colors generally reflect the green of the conifer canopy. However, in the higher elevations as the vegetation becomes more sparse, colors of the exposed rock and soil become apparent.

Lines are probably more obvious in the natural environment of the coniferous forest biome than in any other biome. There are many abrupt changes in vegetation types caused by man or nature. Lines may be evident in the sharp angular surface of exposed rock.

Scale, though easily defined, may become almost overpowering in some areas. Many people are not accustomed to the extreme vertical relief common to this biome. The overall effect varies with the background of the individual observer. To some, mountains are frightening - to others they are a comfortable place to be. The wide variety of forms, textures, colors, and lines make the scenic values in the coniferous forest biome interesting. Vastness of scale and distance bring an awesome feeling of isolation to many visitors within this region.

Human Interest Values

Geological

The montane coniferous forest includes glacial features such as moraines, lakes, and U-shaped valleys. Erosional features like canyons, pinnacles, and mudflows as well as volcanic features such as lava flows, eroded ash beds, exposed plugs, hot springs, and geysers are found in this biome.

The northwest coastal coniferous forest is edged with an eroded coast line of natural arches, isolated rock islands, sand dunes, and steep cliffs. Higher sections of this forest type contain canyons, volcanic features, caves and evidence of faults.

Archeological

The forests were not generally inhabited by native Americans. These people instead lived along water courses and used the forests for hunting and gathering. The peoples of the deserts and grasslands used the coniferous forests that were within range of their traveling ability.

The northwest coastal coniferous forest was the home of the salmon-fishing oriented Northwest Coastal Cultures. Based on the Old Cordilleran Tradition and the Northwest Coastal Tradition, it quickly evolved to become very distinctive with its great use of wood and elaborate art works. Village sites were along the streams and consisted of either pit or surface houses. Occasional rock shelters and some campsites are found away from the streams.

Historical

The coniferous forest tends to share its history with the nearby grasslands and desert. Use was somewhat similar to prehistoric times when most of the campsites occurred in the valleys and few people lived in the forests.

In the northwest coastal coniferous forest, history revolves primarily around the lumbering industry and mining. Fishing and maritime activities are also an important part of the region's past. Russian and British trading activities in the area and similar later efforts by Americans are important facets of the late 18th and early 19th century history.

Cultural

Most of the montane coniferous forest is too high in elevation for any permanent Indian settlements although some are located in nearby areas. Other ethnic/religious groups from the surrounding grasslands and deserts use the montane coniferous forest.

There are only a few groups of Indians living in the Northwest capital coniferous forest.

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PART III

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

Introduction

This part of the statement analyzes impacts of the proposed action without considering mitigative actions. This provides a benchmark for analysis and a perspective of the potential impacts any one action might cause.

Many of the impacts are similar throughout each of the biomes. Where differences do occur, these are identified. The impact on each major environmental component is discussed separately. Adverse impacts which remain after application of possible mitigative measures are described in Part V.

The impacts are categorized by environmental components and discussion under each component is further broken down into the livestock management actions and the supportive measures of the proposal.

Livestock Management actions considered are: adjustment of numbers, changing season, frequency and intensity of livestock use, changing class of livestock, deferment of livestock use, rotation of livestock use, rest from livestock use, distribution of livestock, and/or removal of livestock.

Supportive measures considered are: fencing, corrals, pipelines, ponds, springs, wells, drinking facilities, storage tanks, catchments, roads and trails, vegetation manipulation, animal control, transportation of livestock, and camps. Table I-1 on page I-4 gives a listing of existing and projected supportive measures that are needed to implement the Allotment Management Plan program.

Non-Living Components

Soil

Impacts from Livestock Management Actions

Livestock grazing on NRL will result in soil compaction. Compaction alters the soil microclimate in terms of less pore space, oxygen and reduction in moisture infiltration. This, in turn, affects soil microflora and microfauna. More obvious surface indicators of compaction are increased water runoff and changes in vegetation composition and ground cover. Animal wastes are deposited on the soil surface, introducing foreign pathogens into the soil. However, such wastes enter into natural nutrient cycling processes and provide soil fertility. On relatively small areas where animals congregate, i.e., near water and under shade, impacts of trampling and solid wastes on soil may be deleterius on these small localized areas.

Within all biomes, soils display seasonal changes by loosening of soils during the winter frost period and compaction during the summer rainfall period (1). Grazing on these soils tends to hasten compaction, which increases the volume of surface water runoff and its sediment load (2). A study spanning 14 years demonstrated the effect of grazing on shale-derived soils in western Colorado. No grazing produced a reduction in overland flow (runoff) of 30 percent and sediment-load of 45 percent less than grazed watersheds (2). Studies on other soils and locations have indicated that light grazing on certain grass types does not affect surface runoff and sediment load if the grazing is light enough to prevent significant decrease in vegetative cover (3). However, if the cover is decreased, runoff and sediment-load are adversely affected. Small plot studies in the grassland type in Arizona indicate: (a) winter runoff was independent of the amount of perennial grass vegetation, and (b) total runoff was unaffected by light grazing, but when overgrazing reduced the amount of perennial grass, there was a marked increase in surface runoff and sediment accompanied by a significant decrease in areal infiltration capacity (4). Another small plot study in the coniferous forest biome with fixed amounts of simulated rainfall indicated erosion was more closely related to the amount of vegetative cover than any other site characteristic (5). However, the relation between erosion and cover was strongly influenced by slope gradient, the greater the slope, the greater the susceptibility to erosion.

Tables III-1 and III-2 show the comparison of estimated sediment production between present watershed conditions and watershed conditions when the AMP program is fully implemented.

Management actions, such as reduction in livestock numbers, deferment of use, rotational grazing, rest from grazing, and changing animal distribution patterns will minimize soil compaction. During rest, rotation, and/or deferment, an opportunity is provided to allow natural forces to restore the soil to a natural state (see Figure III-1). In a grazing system, when all the livestock are placed in one pasture, compaction may increase. However, when the animals are rotated to another pasture, the previously compacted soil is "rested" from trampling and, given time, will return to its natural state.

Management actions will have indirect beneficial impacts on the soil through increased ground cover resulting from improved plant density and

Table III-1

Estimated Area by Sediment Production Classes at Present Watershed Condition

Veg. Type	<0.2[1]	0.2-0.5	0.5-1.0	1.0-3.0	>3.0	Area in Sq.Mi.
Grass	4,876[2]	12,574	6,415	1,540	256	25,661
Meadow	136	71	45	0	0	252
Perennial Forb	16	78	13	29	9	145
Sagebrush	12,081	53,817	37,343	5,492	1,098	109,831
Mountain Shrub	617	2,015	1,275	206	0	4,113
Conifer	2,110	1,582	1,213	317	53	5,275
Waste (>2% cover)	234	644	908	702	439	2,927
Pinon-Juniper	1,202	14,427	18,435	5,611	401	40,076
Broadleaf Tree	299	80	59	9	0	447
Creosote	310	4,341	8,373	2,171	310	15,505
Mesquite	23	406	1,063	746	23	2,261
Saltbrush	1,163	9,301	9,301	3,255	233	23,253
Greasewood	619	2,552	3,093	1,392	77	7,733
Winterfat	102	966	558	68	0	1,694
Desert Shrub	1,459	10,209	9,967	2,431	243	24,309
Half Shrub	50	614	551	38	0	1,253
Annuals	859	1,054	319	221	0	2,453
Totals	26,156	114,731	98,931	24,228	3,142	267,188

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[1] Estimated sediment production in acre feet per square mile per year.

[2] Expressed as square miles, e.g., 4,876 sq. miles, yielding <0.2 acre feet sediment per square mile per year.

Table III-2

Estimated Area by Sediment Production Class When the Allotment Management Plan Program is Fully Implemented

Veg. Type	< 0.2[1]	0.2-0.5	0.5-1.0	1.0-3.0	> 3.0	Area in Sq. Mi.
Grass	11,547[2]	12,317	1,283	514	0	25,661
Meadow	234	18	0	0	0	252
Perennial Forbs	N.E.[3]	N.E.	N.E.	N.E.	N.E.	145
Sagebrush	37,343	63,219	8,786	439	44	109,831
Mountain Shrub	823	3,085	205	0	0	4,113
Conifer	3,482	1,476	301	16	0	5,275
Waste (>2% cover)	29	234	878	1,405	381	2,927
Pinon-Juniper	4,008	25,648	8,416	1,603	401	40,076
Broadleaf Tree	N.E.	N.E.	N.E.	N.E.	N.E.	447
Creosote	155	10,854	4,341	155	0	15,505
Mesquite	1,198	520	543	0	0	2,261
Saltbrush	3,720	15,347	3,488	605	93	23,253
Greasewood	1,315	4,485	1,624	309	0	7,733
Winterfat	271	1,372	51	0	0	1,694
Desert Shrub	3,403	15,558	5,105	243	0	24,309
Half Shrub	326	727	200	0	0	1,253
Annuals	2,036	343	74	0	0	2,453
Totals	69,890	155,203	35,295	5,289	919	267,188

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[1] Estimated sediment production expressed as acre feet per square mile per year.

[2] Expressed as square miles.

[3] N.E.-no estimate made because of insufficient sample size.

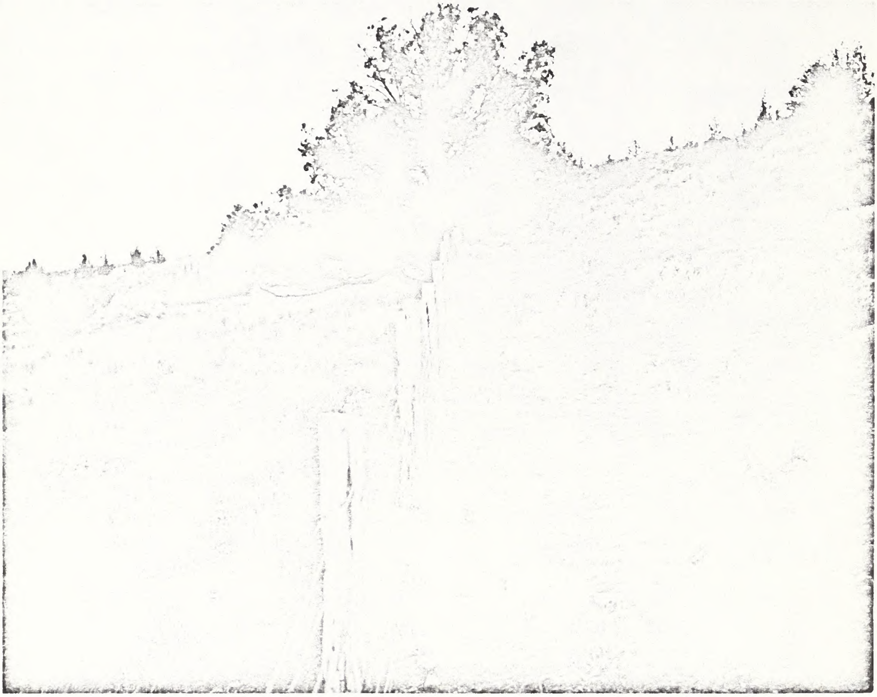

Figure III-1. Ground cover variation due to grazing of livestock. Rest rotation grazing system left of the fence; continuous seasonal grazing on the right.

plant vigor (assuming that overpopulations of wild herbivores are not present). These changes result in associated decreases in overland water flow, salinity, sediment production, compaction and, in some cases, a lowering of ground temperature and reduction in evaporation from the soil surface.

In addition, unutilized vegetation in the rested pastures falls to the ground as litter, providing additional soil protection. Eventually this litter is incorporated into the soil as humus which supports soil bacteria, enriching the soil, increasing moisture absorption and retention, and reducing runoff and subsequent erosion.

When animals are confined in one pasture in rotational grazing systems, they are forced to more uniform distribution throughout the pasture. Animal wastes are, thus, more uniformly distributed. As this pasture is rested from grazing during the rotational sequence, wastes are assimilated into the soil through natural processes.

Impacts from Supportive Measures

Impacts on the soil from one or a combination of the support measures depend on the amount of surface disturbance involved. Right-of-way clearing and construction vehicle activities cause the major disturbance by construction of fences, corrals, roads or trails, and pipeline and water developments. Disturbance of the natural soil surface in many instances results in a concentration of overland flow within an area. When overland flow is concentrated, rill and/or gully erosion may result. In general, the velocity of water movement due to a reduction of the roughness coefficient will increase within a cleared right-of-way, unless a reduction in slope gradient occurs simultaneously. As a result of water concentration and velocity increase, sediment production tends to increase because of the scouring action on loose material within a right-of-way.

Vegetative manipulation practices result in either an increased or decreased overland flow and sediment production, depending on the treatment utilized. Treatments such as chaining, railing, or cabling, have caused increases, decreases or no changes in overland flow or sediment production. The magnitude of the impact is related to many soil and climatic factors as well as physiographic features such as aspect, slope, and elevation, among others. Mechanical treatments utilizing the tree crusher or root plow will virtually eliminate overland flow and sediment production for a period of time.

Chemical treatments in general have less impact on overland flow and/or sediment production than do many mechanical treatments. However, chemicals produce a short-term impact of soil contamination from both the chemical itself and some carriers used, such as diesel oil. The length of time soil contamination persists depends on the chemical used, precipitation on the area, amount of ultraviolet sunlight reaching the soil surface, and amount of organic material present.

The environmental impacts of mechanical and chemical vegetative manipulation practices will be covered in greater detail in other environmental statements which are being prepared. 1/

1/ Mechanical and chemical vegetative manipulation practices are to be covered in the following Environmental Impact Statements: Watershed Programmatic Statement, Pinon-Juniper Chaining Statement, and the Chemical Pesticides Statement.

The use of fire may result in an increase in some soil nutrients and a decrease in others. It may also result in nonwettable soils under some conditions. Meteorological factors present during a burn have a significant effect on the magnitude of the environmental impacts resulting from the treatment. A torrential storm or prolonged precipitation on an area denuded by fire may result in significant rill and gully erosion and loss of soil and soil fertility.

In summary, soil compaction will occur on certain soils as a result of livestock grazing causing changes in soil flora and fauna, decreased moisture infiltration, and increased runoff, sedimentation, and salinity of water where soil salts are prevalent. Livestock management actions utilizing rest, rotation, deferment, better distribution, etc., will minimize these impacts. Such management actions will provide greater soil protection by increasing vegetative vigor and ground cover, thereby decreasing overland flow, salinity, sediment production, and evaporation, and improving the soil microclimate. Unused vegetation in rested pastures falls to the ground as litter and is incorporated into the soil as humus.

Supportive measures which disturb the vegetation and natural soil surface may result in beneficial or adverse impacts on the soil. Construction activities for pipelines, roads and trails, etc., disturb the soil in localized areas and may initiate erosive processes. Vegetative manipulative practices (mechanical or chemical treatment and fire) may adversely affect soil for a short time but, in the long time period, should result in better vegetative cover for soil protection.

The impact of the proposed action will substantially improve the ability of the watershed to withstand soil erosion. Predicted soil erosion condition classes by vegetative type are shown in Appendix II-A-1(a) on page II-A-2. This can be compared with the present situation shown in Appendix II-A-1.

Water

Impacts from Livestock Management Actions

Domestic livestock must have access to water. Even under the management program as proposed, certain adverse impacts will result over a short period of time where livestock have access to streams or bodies of water. However, over a longer time frame, deferment, rotation, rest, and other management actions will improve streamside vegetative cover and composition. Grazing systems will restore streamside vegetation thus stabilizing streambanks and water temperatures (6) and improving water quality.

During the short period when a pasture is grazed in a rest-rotation grazing system, they will utilize streamside and aquatic vegetation, temporarily reducing vegetative cover and overhang. This may result in some increased sedimentation and water temperature. Animals wading into streams or bodies of water disturb favorable poolriffle relationships. In both streams and reservoirs the water may become clouded and muddy from fine sediments which affect aquatic food organisms and spawning beds of some fish species. Also animal excreta will be deposited into the water. These impacts would be confined to only one pasture at any one point in time since other pastures in the grazing system are being rested at this time.

"The pollution potential from wastes of livestock on pasture may be significant if the topography of the land favors a high rate of runoff into a nearby stream and if grazing patterns are such that waste accumulates chiefly in small areas close to surface waters. Limited data are available on the actual impact of livestock wastes on stream water quality in grassland or pasture. However, it appears that the water pollution potential from animal wastes in grazing pastures and grasslands should be minimal under good range management practices." [2/]

In many areas, especially in the desert biome and southern temperate grassland area, reduced vegetative competition from grasses due to past overgrazing has contributed to the invasion of many deep-rooted woody species (see Figure III-2). These have a higher demand for soil moisture consumption than do herbaceous plants. This causes greater competition resulting in additional loss of grass plants which allows gullies to develop. These gullies drain soil moisture from the areas and add sediments and salts to streams and reservoirs, increasing turbidity and decreasing water quality.

As a result of increased water consumption by deep-rooted woody species and the loss of protective herbaceous cover, several historically known springs and seeps have dried up. In contrast, lack of ground cover resulting from past overgrazing permitted water runoff to fill earthen tanks

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[2/] Methods for Identifying and Evaluating the Nature and Extent of Nonpoint Sources of Pollutants. U.S. Environmental Protection Agency, Office of Air and Water Programs, Washington, D.C.; U.S. Government Printing Office. EPA - 430/9-73-014. 1973.

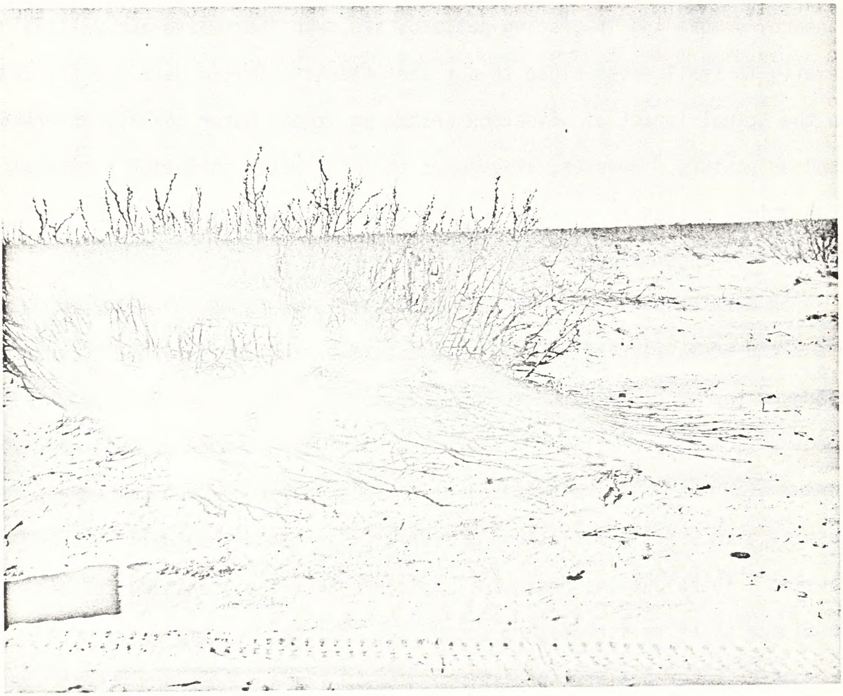

Figure III-2. Mesquite invasion in the southern grasslands has drastically reduced the soil moisture available for other plants and, in effect, produced a monotype.

(b) will, in most instances, reduce overland flow of water and salinity to irrigation water storage reservoirs; and

(c) will induce some springs (aquifers) to reflow.

Impacts from Supportive Measures

Some support measures affect water quality to a greater extent than others. Any support measure having a soil surface disturbance feature as an integral part may adversely affect water quality of a pond or small stream. In general, such a support measure would not affect a stream with a large flow for more than a short distance. Usually, water quality degradation would occur only on very small perennial or intermittent streams and standing bodies of water. Right-of-way clearings (as shown under Soils) could also result in a short-term water quality degradation due to increased sediments.

Mechanical vegetative manipulation practices adjacent to or near the water body or stream may or may not decrease sediments, depending on the type of treatment, and if an increase in overland flow occurs. Studies in Arizona have shown that sediment production did not increase following pinon-juniper manipulation (7, 8), while in Utah it was reported that the factors influencing sediment discharge were so variable from one area to another that they could not predict the sediment production following treatment (9).

The impact of chemical vegetative manipulation treatments on water depends on the proximity of the treatment area to the water body. It has been shown that phenoxy chemicals released during a direct overflight of a live stream are detectable for only a short distance downstream and then for a short period of time (10).

and reservoirs. However, frequently such runoff contained a high concentration of salts adding to the salinity of streams and reservoirs.

As stated in the soil section, the proposed management actions will result in an increased ground cover which benefits soil moisture and lowers sediment production. Improved ground cover on soils containing high amounts of salts will decrease salinity of downstream bodies of water. This will improve the water quality in both streams and reservoirs. Management actions such as removal of livestock, deferment of use, and rotational use, lessen impacts of grazing on stream banks.

It is doubtful if management action alone, including removal of livestock, will change the impact of some of the invading deep-rooted woody species and their effect on soil moisture. However, a combination of various treatment practices with various management actions can minimize the woody species in an area and improve soil moisture relationships, thus stimulating growth of residual vegetation and decreasing erosion hazards.

Management actions resulting in improved vegetative cover and composition, and more litter will (and has in some instances in the present AMPs) restore water flow in previously dry springs and seeps. By the same token, increased herbaceous ground cover has reduced or eliminated runoff in some cases and some ponds and reservoirs have gone dry.

An increase in vegetation through management:

(a) will, in most instances, reduce the overland flow sedimentation and salinity to reservoirs and require the development of new water sources;

Table III-3, shows the estimated consumptive water requirements on NRL in seven western states for livestock, wildlife and water impoundments.

Air

Impacts from Livestock Management Actions

Any of the management actions resulting in an increase in ground cover, through either increased density or plant canopy cover, will have a beneficial impact on air quality. Air pollution resulting from livestock grazing is from two major sources: (a) from the animal itself (odor), and (b) from dust particulate matter.

The air pollution from animal odor is negligible. Only the management action of livestock removal will have any effect on this type of air pollution. Even if the animals are shipped out, there would probably be no measurable effect on air quality over the entire biome. The air quality in localized areas might be improved.

The second form of air pollution, dust particulate matter, may be affected by livestock removal. The majority of the management actions are designed to provide a more effective ground cover through increased litter, plant density, or vigor (see Figure III-3). An associated reduction in exposed soil will result in less dust particulate matter being picked up by the surface winds.

There are areas of fine clays or sands within the grassland and desert biomes which are very susceptible to wind erosion. Spring grazing on portions of these biomes has resulted in near eradication of cool season grasses, forbs and browse plants. Spring deferment will result in an increased ground cover during this windy season on those areas where cool season plants were once a part of the plant community.

Fire as a vegetative manipulation practice can affect water quality if the ash gets into the water. Again, the distance between the treatment areas and the water body would have a direct correlation to the amount of water quality degradation. Ash content, if allowed to reach the water body or stream, could act much like fertilizer by increasing eutrophication, algae bloom, and lowering water quality for fish by decreasing dissolved oxygen content.

To summarize, when livestock have access to streams or bodies of water they will consume streamside and aquatic vegetation, wade into the water, and deposit animal wastes in the water, all of which affects the aquatic environment particularly for fish. However, under the management proposal, such impacts are minimized by rest, deferment, rotation, etc., and are of short duration. In the long run, streamside and aquatic vegetation will be improved by proper livestock management. Restoration of a more natural vegetative composition and increased ground cover from proper livestock management will decrease the spread of deep-rooted woody species which have a high demand for soil moisture, decrease erosion, and sedimentation and salinity of streams and reservoirs. Increased herbaceous ground cover will restore water flow in previously dry springs and will reduce runoff to ponds and reservoirs.

The annual consumptive water use of livestock grazing on NRL is estimated at nearly five billion gallons. This will increase to approximately six billion gallons or 18,400 acre feet yearly by 1990 as the AMP program is implemented. The additional construction of approximately 25,000 small reservoirs will increase the amount of evapo-transpiration.

Table III-3

Annual Consumptive Water Requirements in acre feet for the states of Colorado, New Mexico, Arizona, Nevada, Idaho, Oregon and Washington for National Resource Lands.[3/]

Use	1972	1980	2000	2020
Wildlife	433,762	446,091	514,792	536,942
Livestock	14,099	15,581	18,303	24,703
Impoundments*	92,343	98,648	102,936	104,005

*Includes evapo-transpiration which varies from an average annual rate of 70" in New Mexico to 25" in Northern Idaho.

[3/] Provided as preliminary data of the Western U.S. Water Plan. Data for California, Montana, Utah and Wyoming are not available at this time.

Figure III-3. Following grazing treatment, surface litter and seedling plants remain, providing soil protection.

The action of rotational grazing may result in increased soil exposures and air pollution for a short time in a pasture being utilized. Other areas however, would be rested to renew vigor, for seed production, and the establishment of seedlings during the same period. In the south temperate grasslands and hot desert portions of the desert biome, this treatment may result in an increase in dust particulate matter pollution because of a greater probability of drought following the grazing treatment.

Impacts from Supportive Measures

When implementation of a management action requires support measures that disturb the soil surface or vegetative cover, there will be a localized impact on air quality. Soil surface disturbance results in a greater probability of increased dust particulate matter entering the air.

Support measures such as fence construction, pipeline installation, water developments, roads and trails, and the transportation of livestock can all result in some degree of surface disturbance. The magnitude of of the impact of surface disturbance will vary according to the biome in which it occurs. Clearing rights-of-ways in the hot desert or south temperate grassland will have a much longer effect on the air quality than the same action in the coniferous forest or woodland-bushland biomes. Climate to a large degree influences the longevity of this impact, as it regulates the plant growth necessary to stabilize the site.

Roads and trails, because of their permanent nature, will have a longer lasting impact on air quality than other support measures, primarily due to vehicular traffic.

Water development and corrals may cause a concentration of livestock for short periods of time which may lower air quality due to odor and dust on these areas.

Vegetative manipulation projects necessary to support management actions could have an influence on air quality for a short time but, in general, will result in an enhancement of the air quality over a long period of time by improving vegetative cover.

Mechanical treatments may result in an increase of dust particulate matter until the area is revegetated. Some minor amounts of hydrocarbons would be put into the atmosphere from the equipment required to do the job.

Chemical treatment of vegetation may result in introduction of chlorinated hydrocarbons into the atmosphere, depending on the chemical used and method of application (see Figure III-4). Even considering aerial spraying which would put the largest amount in the atmosphere, there is no reason to believe the effect on air quality would last more than a few weeks (11).

Manual placement of pelleted or powdered chemicals for vegetal control would cause no adverse impacts on air quality.

Any of the support measures can result in a beneficial impact to air quality if they solve an existing problem. If no specific air quality problems existed prior to the implementation of a management action and the necessary support measures, there would not be a beneficial change in air quality.

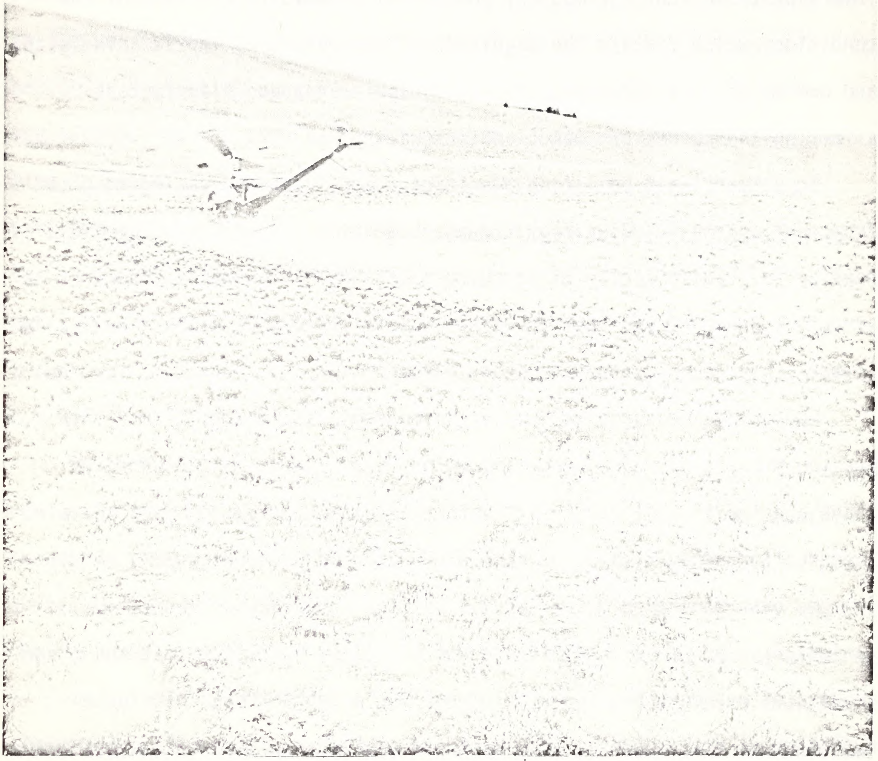

Figure III-4. Chemicals are introduced into the atmosphere during a vegetative control treatment.

Fire as a vegetative manipulation practice is not often used on the NRL. However, fire as a cleanup for some other treatment, such as chaining, is used to some extent. Air quality degradation can result if proper burning conditions are not present during treatment. Temperature inversions, stagnant air masses, and relative humidity are some of the conditions which dictate the magnitude of the resulting impact. The size and number of fires within a given geographic area are also factors affecting the degree of impact on air quality.

In summary, air pollution resulting from livestock grazing results from odor and dust. Odor from livestock grazing on spacious rangelands is negligible. The majority of management actions will provide a more effective ground cover from increased vegetative vigor, plant density, and litter, thus reducing the amount of exposed soil.

Supportive measures which disturb the soil surface will result in greater probability of air pollution from dust. Vehicular traffic on roads and trails will result in dust particulate matter entering the air. Construction activities associated with water developments would result in some dust pollution for a short time in a local area. Vegetative manipulation projects may influence air quality, both from dust and minor amounts of hydrocarbons from equipment, for a short time, chlorinated hydrocarbons from chemical treatment and smoke from fires will degrade air quality in the short term. Vegetative manipulation projects will ultimately result in enhancement of air quality by improving vegetative cover and composition.

Living Components

Vegetation

Impacts from Livestock Management Actions

Removal of livestock from specific areas such as critical wildlife habitat, frail soils, recreation sites, etc., may be beneficial to the vegetation. Vegetation will develop under natural processes to its ecological potential except as wild herbivores and insects consume vegetation. If the void left by livestock is filled with game animals without proper management, vegetation may still be adversely affected.

Reduction in numbers will have somewhat similar beneficial effects on the vegetation. However, even fewer domestic animals will still congregate in favored locations causing vegetation destruction and soil compaction by trampling. Reduction in numbers would reduce the consumption of vegetation, but would not reduce soil compaction in localized areas.

Changing season of use, i.e., from spring to summer grazing for example, removes grazing pressure during a critical period of vegetation growth. In the spring when growth begins, heavy withdrawal is made of stored carbohydrates in the roots and basal portions of the plant to produce new vegetative shoots. Use of stored carbohydrates continues until sufficient green growth is produced for photosynthesis. As growth develops, the plant manufactures increasing amounts of carbohydrates and relies less on stored carbohydrates. Eventually, carbohydrates produced in excess of current needs are stored again in roots and other plant parts. Grazing in the spring season removes developing photosynthetic tissues and retards manufacture of carbohydrates. Constant replacement of these tissues removed by grazing requires additional withdrawal of stored carbohydrates. If this continues during the spring season, plants are seriously weakened or even destroyed. Since cool-season plants are the first to "green up" in the spring, they generally are relished by livestock that have just completed a winter grazing dry vegetation. Because of continued yearlong use, including spring, in the southern grassland and hot desert biomes, early developing cool-season species have largely been eliminated or greatly reduced in the total vegetative ecosystem. Thus, it would be beneficial to change the season of use, defer grazing in the spring, or rest and rotate spring grazing use.

In Utah, grazing on cold desert shrubs and grasses during the summer period has been shown to be detrimental to the vegetation (12). Changing season of use from summer to winter grazing, reduction of numbers, deferment from grazing, or rotation of use will be beneficial to this vegetative type.

Reduction in the frequency of use would reduce utilization of the vegetation--particularly highly palatable species--and permit improved growth, production, and reproduction of all plants.

Deferment or rotation of grazing use are management actions which delay grazing or rotate grazing animals between pastures. These actions permit normal plant development processes with minimal disruption. The timing and length of deferment and the sequence of rotation among pastures are designed to meet plant growth requirements (see Figures III-5 and III-6). For example, the purpose of spring deferment may be to permit plants to gain vigor and store reserve carbohydrates, produce seed and additional forage, allow seedling establishment, reserve the early green spring vegetation for wildlife, and provide additional soil protection

Figure III-5. Area shows reduced soil protection particularly on stream banks. Photo taken 6/21/61.

Figure III-6. Same area as Figure III-5. Photo taken 9/11/64. Area is under rest rotation grazing system.

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from wind in the spring months. Rotation of use among pastures is designed in a sequence which serves the same beneficial effects. For example, plants may be rested in a pasture until seed is mature. Grazing use is then rotated into that pasture to assist in shattering, scattering, and planting the seed by trampling and scarifying the soil surface through hoof actions of animals. This pasture is then rested again to permit new seedlings to become established and develop, thus providing additional forage, soil protection, and altering the vegetative composition. Deferment and rotation of grazing use are management actions applied to benefit the vegetative resources.

Management actions taken to obtain better distribution of grazing use are beneficial to the vegetative resource as a whole. It will force utilization of vegetation on previously ungrazed areas and reduce grazing pressure on favored vegetation on more accessible sites. Better distribution results in more uniform use throughout the grazing area.

The proposed management program will ameliorate selective grazing of preferred forage species. Confining animals into smaller pasture subdivisions forces better distribution of animals in their search to fulfill their forage requirements. In essence, foraging animals concentrated in a smaller unit will make more uniform use of the entire unit, and are forced to utilize plants not otherwise grazed. These less perferred species may be just as nutritious as others but are seldom grazed if animals have free choice. Although selective grazing of the more palatable plants and plant parts will continue, other less palatable plants will share the grazing load as the animal seeks its daily forage requirements. When all plants are utilized more or less uniformly, none has a competitive ecological advantage.

Previously, less preferred and ungrazed species had a competitive advantage over grazed species because as they declined, the former would occupy the site.

Impacts From Supportive Measures

Construction of fences to implement a management action would have minimal short-term localized effects on vegetation, causing slight disturbance due to equipment operation and construction activities. Some vegetation will be disturbed along the fence line (see Figure III-7).

Construction of corrals, pipelines, drinking facilities, storage tanks, catchments, roads and trails removes vegetation in localized areas. Trenching for pipelines can destroy vegetation in a strip several feet wide for the length of the pipeline. Development of roads and trails destroys vegetation for the length of the trail or road. Dust from these roads and trails and pollutants from vehicles will settle on or be absorbed by vegetation. However, impacts on vegetation of dust and vehicular emissions will be localized and minimal because of infrequent use of many roads and trails.

Manipulation of vegetation by some mechanical or chemical means, or by controlled fire, is almost totally destructive to the target species. Others may be destroyed, too. Fire and some mechanical treatments eliminate most woody species but grasses are normally not permanently affected. Chemical sprays and mechanical treatments can be conducted in a manner to provide only partial vegetative kill, depending on the treatment necessary for a grazing management action. Reduction of competing brush results in greater soil moisture and light penetration providing an opportunity for suppressed plant species to achieve greater vigor and develop naturally.

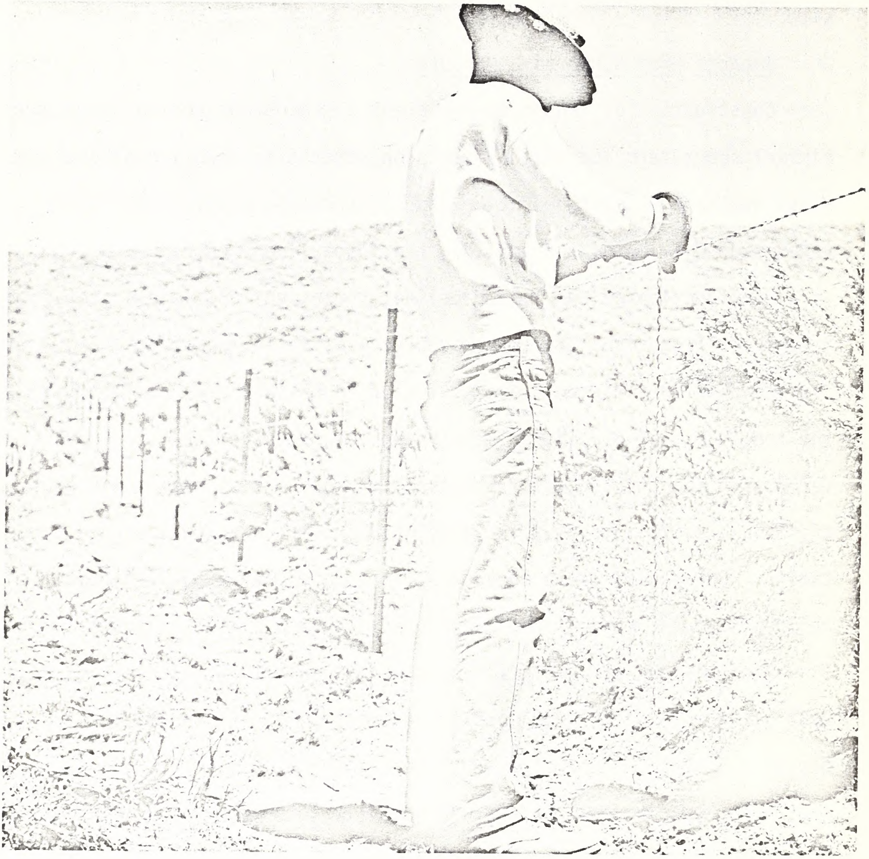

Figure III-7. Fence as constructed in the past. Note the removal of vegetation along the fence.

Vegetative manipulative measures would be beneficial to the vegetation remaining on the site by removing competition and providing better moisture infiltration.

Construction and use of sheep camps and line cabins have a detrimental effect on vegetation in localized areas around such structures. Line cabins are used infrequently and effects of human and animal activity near the cabin are short-lived.

Sheep campsites may be denuded of vegetation if salt and water are provided adjacent to the site, or if the area is used for veterinary treatment at the camp.

Predator control practices have no influence on vegetation. Insect and rodent control will be beneficial to vegetation since such organisms are primary consumers of vegetation. However, some rodents do collect and cache seeds, some of which sprout and develop into new plants. In addition, many of these organisms do play a vital role in the ecosystem in the decomposition of organic material, recycling of nutrients, fertilization of flowers, food chains, energy flow, etc.

In summary, all of the livestock management actions are applied in specific situations to provide the vegetation an opportunity to complete normal life processes and, at the same time, to harvest the annual production of usable forage. In essence, each management action is applied to permit plant physiological and ecological functions to proceed with a minimum of disruptions. With rest, deferment, rotation, etc., plants are able to synthesize and store food, produce seed which is scattered and planted by livestock trampling, and establish new seedlings of ecologically adapted species. Over time, these actions will restore vegetative cover and composition to a near normal ecological status.

Supportive measures involving construction of fences, water development, building roads, etc., will have short-term localized effects on vegetation. Mechanical and chemical treatments, and controlled fire will mostly eliminate the target species from the treated area but will make the site more desirable for the remaining vegetation. Control of insects and rodents would be beneficial to vegetation but would also disrupt the vital role they play in food chains, decomposition of organic material, and recycling of nutrients.

Wildlife

Impacts from Livestock Management Actions

Other than livestock removal, each of the proposed management actions will result in some continued degree of competition with wildlife. Each action will be initiated with the specific objective of improving the vegetative resource and, in the long run, will provide more food and cover for wildlife. Properly applied periods of grazing use will reduce competition between livestock and wildlife (see Figure III-8 and Figure III-9). A change in season of use by livestock can prevent livestock use of browse species important to wintering deer populations or forbs utilized by antelope. Utilization of grass in the spring, when it is most susceptible to grazing damage, reduces vegetative competition with important wildlife browse plants. Changing class of livestock can reduce competition or improve compatibility with wildlife. As an example, where grass species are common, domestic sheep compete more actively for browse

Figure III-8. Severely grazed cliffrose plants show the result of livestock-wildlife grazing competition. Fall and winter grazing by livestock on big game range frequently forces livestock utilization on browse species to meet their nutritional requirements.

Figure III-9. Cliffrose plant recovering after one year deferment of livestock grazing. This and other management actions are taken to enhance wildlife habitat.

species important to deer populations than will cattle. Excessive use of wildlife habitat by cattle and sheep can be reduced by adjustment in livestock numbers.

Rotation of use can lead to direct competition with wildlife in use pastures. In these situations, the quality of wildlife habitat will deteriorate on a short-term basis. On the other hand, pastures rested from domestic grazing use provide the entire vegetative resource for exclusive use by wildlife. Improved plant vigor and density may be anticipated as the rest-rotation progresses. In the long term, wildlife habitat will improve where grazing systems have been implemented on areas suitable for livestock use (see Figure III-10).

It is known that reservoirs in grazing allotments where a management system has been implemented, compared to unmanaged allotments, produced considerably more shoreline and submergent vegetation resulting in a 350 percent increase in number of broods of migratory waterfowl (13). Also broods from reservoirs in managed areas were larger than those from unmanaged areas. At least part of this success is due to the more luxuriant vegetation growing adjacent to the reservoirs (within 100 yards) resulting from the grazing system and used for nesting habitat. The "key" here is that the grazing system be designed in such a way that this habitat not be grazed too closely (leaving a residual for nesting) and that grazing animals not be allowed into the pasture until the broods are hatched and reach the water to prevent trampling of nests and eggs near the water.

Removal of livestock from an area will eliminate the competition for forage, cover, and space between livestock and wildlife. It will allow

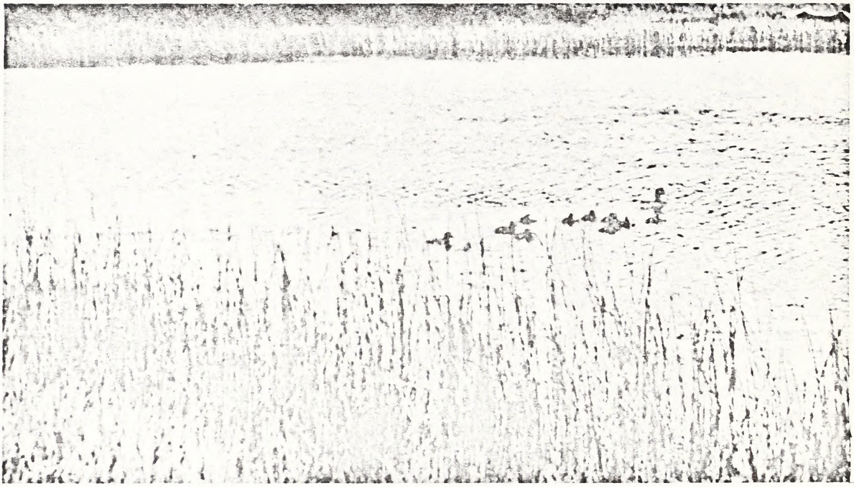

Figure III-10. Shoreline recovery as a result of rest-rotation grazing treatment.

natural regeneration of wildlife habitat subject only to the grazing impact of wildlife and wild horses and burros. Livestock removal from portions of some grazing allotments will be required to protect critical wildlife values in all of the biomes. On those areas where livestock are removed, initial impacts beneficial to wildlife would be increased forage and cover. Stream and pond shorelines would recover and sedimentation and organic pollution caused by livestock would be eliminated. Fish habitat would be improved and water temperatures moderated by the influence of improved vegetative cover along streams and other water bodies. The process of eutrophication would be slowed. The potential for cutting new channels or altering the existing water course would be reduced.

Exclusive use by wildlife may diminish the initial beneficial impacts of livestock removal on wildlife habitat. Light grazing of important wildlife browse plants by livestock stimulates lateral bud development and increases the production of new and tender shoots for wildlife. When livestock are removed, these plants lose the hedged growth form and vertical growth increases resulting in a loss of forage for wildlife. Some forage plants become rank from nonuse and contain old growth unpalatable to wildlife. Unused grasses and forbs would increase the fire hazard. The potential for extensive loss of wildlife habitat by wildfire could be increased. The immediate effect could be serious, but in the long run wildfires may result in improved wildlife habitat in certain plant communities. Private livestock water developments permited on NRL would no longer be mainted by the livestock operator. The reduction of available water in such areas would make wildlife habitat less usable.

Impacts from Supportive Measures

Development of water facilities results in improved availability for wildlife. Where this occurs in suitable habitat, distribution and numbers of wildlife could be improved (see Figure III-11). Water development can also result in adverse impacts on wildlife habitat if it increases livestock concentration in wildlife habitat areas. This could result in forcing wildlife out of the area to a less suitable habitat. Some wildlife could not adjust, and by natural instinct would remain in the area and perish.

Some kinds of fences, although facilitating establishment of rotation systems, create adverse impacts to some kinds of wildlife. Fences impede natural movements or migrations of indigenous big game animals. Pasture and right-of-way fences of woven wire in Wyoming restricted winter migrations of antelope under severe storm conditions and are considered to have caused extensive mortality (14). Improperly designed fences along the highway rights-of-way contributed to the loss of bighorn sheep in Arizona. Wildlife benefits from fences constructed to provide for control and management of livestock will be realized where vegetative conditions improve.

Each individual fence may or may not adversely affect wildlife movements. However, several thousand miles of fencing to implement the management proposal may, cumulatively, have serious adverse effects on big game movements unless construction standards mitigate adverse impacts. On the other hand, fencing to implement management of livestock grazing

Figure III-11 Sagegrouse watering at a livestock reservoir. These reservoirs provide important sources of water for wildlife as well as livestock.

will improve vegetative conditions for wildlife food and cover in addition to development of additional water facilities.

Vegetative manipulation can have either adverse or beneficial effects on wildlife habitat. Areas of low wildlife productivity can be rehabilitated or they can become even less productive for wildlife. Old age stands of pinon-juniper can be opened to allow for improved growth of palatable understory plant species. Improved forage production on productive soils can reduce livestock-wildlife competition. Manipulation could result in a severe disruption of the life cycle of certain species, especially groundnesting species. Manipulation along streams could have serious effects on aquatic life. Removal of adjacent vegetation could increase sedimentation and alter water temperature.

Animal control measures impact wildlife in several ways. The normal predator-prey relationship can be changed. A reduction in predator numbers does not necessarily assure an increase in numbers of prey species where other habitat or physiological factors may control the population. An abundance of predators does not, on the other hand, prevent an increase of cyclic populations of rabbits or rodents. Control measures, such as poisoning and trapping, are not selective and may result in the killing of nontarget species. Executive Order No. 11643 prohibits the use of chemical toxicants, which cause secondary poisoning effects, in predator control programs on NRL.

Predator control has been effective in aiding the reestablishment of important wildlife species on some areas. The survival of young has been improved by predator control.

Rodent control practices disrupt the normal food chain and the life processes of the target species. In addition, secondary poisoning may occur to scavengers. However, rodents have been known to girdle wildlife browse plants resulting in their death. Control in such instances would benefit wildlife.

Generally, road and trail construction is considered to be detrimental to many forms of wildlife. Construction activities can disrupt life cycles and scatter wildlife out of their normal range. Breeding, nesting and production of offspring are especially susceptible during construction activities. Roads often cause changes in wildlife migration patterns. In some cases, however, access roads for hunters will allow better harvests of big game resulting in a more balanced ecosystem.

In summary, livestock grazing will result in some degree of competition with wildlife but such competition will be minimized or, in some cases, eliminated where corrective livestock management actions are applied. Each management action, in the long run, will provide improved vegetative resources and more food and cover for wildlife. Livestock can be managed in a fashion to eliminate or reduce grass competition with wildlife browse. Proper livestock management can be used to maintain important browse species in a hedged and vigorous growth form accessible to wildlife.

Development of additional water to implement a management system is beneficial to wildlife. Fence construction can be accomplished in a manner that minimizes adverse impacts on big game migration. Mechanical and chemical manipulation may adversely affect wildlife for a short period of time but will ultimately result in improved habitat when done properly. Animal control measures, such as predator and rodent control, disrupt the predator-prey relationship and the normal food chain and life processes. Road and trail construction, and construction activities, will adversely affect wildlife in the immediate area and may cause changes in migration patterns. But additional access will provide recreation viewing of wildlife and permit better harvests of excessive numbers.

Domestic Animals

Impacts from Livestock Management Actions

The proposed management actions will have a wide variety of impacts on domestic animals. Many times these impacts will be adverse over a short time period, but may become beneficial over a longer time frame. An example of this could occur when one of the proposed management actions (i.e., changing of season, or frequency of use, deferment of grazing, or rotation of use) is implemented. In most instances, these actions will result in an increase in animal density per unit area. This, in turn, may temporarily lower the nutritive value of the animal's diet thereby causing a drop in animal condition. However, in the long run, if the vegetative response is such that an increase in the primary dietary plants occurs, the nutrient values of the animal's diet will improve and so will the individual's condition. It has been shown that adjusting numbers to or below the productive capacity of an area results in an increase in the animal weight gain (15).

The implementation of rotational grazing may result in an adverse or beneficial impact on the animal. This would depend on several things, e.g., the stocking rate or range condition prior to the implementation of the rotation system. Some studies have shown an increase in animal gains with a change from season-long, or year long use to a rotational scheme (16, 17, 18, 19, 20). Other studies have shown a decrease in animal gains under similar changes (16, 21, 22, 23, 24, 25).

Many of the proposed management actions cause an increase in the movement of livestock from one area to another. Each time the animals are moved, it has an adverse effect on them because an adjustment period is necessary to adapt to a different grazing area. The animals also become excited when handled by man, and an adjustment period is required for the excitement level to return to normal. These two items will reduce the gain per day of the animals while they are being moved and through the adjustment period.

Impacts from Supportive Measures

Construction of fences may have an adverse impact on domestic animals because human activity and machinery noise may excite the animal. The addition of a fence will force the animal to change his grazing pattern in many cases. However, the main effect of the fence will result from the confinement. The basic reason for fences is to force animals to stay on or off an area. In either case, their free choice of movement is disrupted and often will change the nutritive values of their diet. This temporarily lowers the individual animal's condition.

There would also be some beneficial impacts of fences on domestic animals. For instance, the purpose of the fence may be to keep livestock away from a hazardous area such as highways, railroads, or poisonous plants. Combinations of fencing and one or more of the other management actions may provide a stimulus to the vegetation so that quality of the animal diet is raised. This would result in an improvement in the animal's condition.

Water development has a beneficial impact on domestic animals. Domestic animals spend a certain amount of time drinking and going to or from water. Additional water developments reduce this travel time. In the hotter climates, loafing time at water seems to be related to the distances the animal travels.

Roads and trails can have an adverse impact on domestic animals. They can present physical and health hazards to the animals. The physical hazard is the danger of being struck by a vehicle and being lamed or killed. The health hazard would be from dust and from the vegetation covered by dust adjacent to nonsurfaced roads. Respiratory disorders can occur if the animal is exposed to excessive dust.

When livestock on roads or trails are approached by humans or vehicles they often become frightened and run for some distance. This results in anxiety and loss of weight temporarily. It can also separate cows from calves, lambs from ewes, and disrupt distribution patterns.

Roads and trails can have a beneficial impact on livestock by opening up areas to grazing that before were inaccessible or very difficult to reach.

Mechanical vegetative practices may have a short-term adverse impact on domestic animals. Many mechanical treatments tend to loosen the soil to some depth. This can make the terrain difficult for the animal to travel until the soil has settled to approximately its original firmness.

Practices such as chaining leaves debris which affects the mobility of the animal in traversing the treatment area. In the hotter, drier climates, removal of shade trees may also tend to lower the animal's condition.

Chemical treatment such as sagebrush spraying would have no impact on domestic animals since BLM's policy is that all domestic animals have to be removed from a chemical treatment area for two consecutive growing seasons.

Trailing of domestic animals is believed to have an adverse impact on the animal. Sheep, especially, can develop sore hooves. Many animals either lose weight or the daily weight gain virtually stops during trailing. Dust from trailing affects the respiratory process. Weight losses and respiratory problems would apply to trucking also. However, the adverse effect to the animal may not be quite so severe as trailing because less time is usually involved. During trucking, some animals may be injured. Abrupt changes from one vegetative type to another can result in a severe and sometimes fatal change in the physiological processes of the animal.

To summarize, management actions requiring periodic movement of livestock and changes in diet as animals are rotated to fresh feed, may cause temporary weight losses and excitement. However, over a longer time period, improved vegetative conditions will provide more forage and improved nutrition.

Additional fences to implement a management action will confine livestock to an area or prohibit their use of other areas such as frail soils, critical wildlife habitat, recreation sites, etc. However, use of fences to control animal use and provide rotation among pastures is important to improving vegetative quantity and quality. Additional water development is beneficial to livestock and permits better distribution. New roads and trails open previously inaccessible areas to grazing but provide a hazard from vehicular impact and respiratory disorders from dust. Mechanical and chemical treatment may have short-term adverse effects on livestock but will result ultimately in more and better quality forage. Trailing and trucking of livestock may result in occasional injury, weight loss, and respiratory disorders.

Wild Horses and Burros

Impacts from Livestock Management Actions

Livestock grazing management actions imposed where wild free-roaming horses and burros are on NRL will be beneficial to horses and burros. Such actions as removal of livestock, adjusting numbers, season, and frequency of use, and deferment and rotation of grazing use will have the effect of providing more forage for wild horses and burros. The success of the management action will also be affected by the management of wild horses and burros. In instances where cattle and wild horses or burros graze the same area, some competition for forage, water and space exists, particularly if domestic livestock numbers are increased (see Figure III-12).

Impacts from Supportive Measures

Fencing as a supportive measure to implement a grazing management action adversely affects the free-roaming nature of wild horses and burros.

Fencing would confine the horses and burros, disrupting their normal movements and migration patterns. Frightened animals may attempt to run through a fence or jump over it, resulting in serious cuts or broken bones.

Figure III-12. Wild burros on NRL.

However, fencing to control livestock grazing will result in more forage available for all grazing animals, including wild horses and burros.

Development of water (ponds, springs, wells, pipelines, etc.) would be beneficial in providing more dispersement of water for wild horses and burros.

Construction and use of roads and trails frightens wild horses and burros. However, these roads and trails provide better access for observation of the animals by the general public, unless human activity forces the animals to more remote areas.

Vegetative manipulation practices provide more and better quality forage for horses and burros. However, the activities and machinery involved in vegetation manipulation frightens the animals and may destroy their cover used for escape and hiding. Treatments, such as contour furrowing, pitting, etc., which roughen the soil surface may result in insecure footing and subsequent injury. Downed woody vegetation, such as pinon-juniper, will impede the free-roaming nature of horses and burros. Fire as a vegetative manipulative measure in their habitat destroys the vegetation for a short time and may completely eliminate some species preferred by horses and burros.

The extent of predation on wild horses and burros is unknown. Generally, the population of these animals is considered to have increased in numbers without implementation of specific predator control programs for their benefit.

Elimination of predators which prey on sick, maimed, diseased, and weakened wild horses and burros could be an adverse impact. The removal of these animals under normal predation processes tends to maintain a healthier herd. In situations where population control measures are nonexistent, predation may aid in preventing populations from exceeding the range carrying capacity.

Control of insects and rodents which compete for forage would be beneficial to horses and burros by making more forage available. However, these organisms are important in the functioning of the ecosystem.

Human activity associated with sheep camps and line cabins tends to frighten wild horses and burros in the area.

To summarize, management of livestock grazing will benefit wild horses and burros by providing more forage resulting from improved vegetative conditions. Some competition for forage may exist in certain instances.

Construction of additional fences may disrupt movement and migration of wild horses and burros and construction activities for fences, roads, water developments may frighten animals in the area. Development of additional water will benefit wild horses and burros and other animals. Mechanical treatments of vegetation which roughens the soil surface or leaves vegetative debris will impede the free-roaming nature of wild horses and burros. However, in the long run, such practices should improve vegetative quantity and quality for these animals. Predation tends to maintain a healthier herd so that predator control practices may adversely affect wild horses and burros.

Humans

The proposal will have an impact on livestock operators subjected to the intensified management system. This means most operators holding grazing privileges. It will require an intensification of livestock management and investment in supportive measures in many situations that will require additional manpower and expenditures. The implementation of AMPs will involve individual or a combination of actions related to changing season or frequency of use, deferred or rotation grazing. This will disrupt traditional ways of livestock operations. It may be necessary to hire additional labor, buy additional equipment, acquire additional private land forage, or forego other endeavors. The operator may be required to move livestock regularly and to construct or maintain range improvements as a condition of the grazing authorization. This involvement is a normal commitment practiced by many ranchers on existing AMPs and to a lesser extent on some other livestock grazing allotments.

The proposal will have a favorable impact on the livestock operator from the standpoint of realizing increased productivity through better forage, better control of animals, and economic stability. The exception would be to those operators where removal or reduction in numbers occurs on portions of their allotment.

The economic analysis procedures, assumptions, and approach are explained in Appendix III-A.

The result of the proposed action in the grassland biome is expected to increase the livestock AUMs on NRL by about 1,830,000 to a total of 5,230,000. The increased feed is estimated to raise annual earnings of the livestock industry by $7,600,000; when the multiplier effects in regional economies are included (see Table III-4), the total effect on annual personal income flows in the biome is estimated at $11,600,000. These figures represent about a 1.5 percent increase in livestock earnings and less than 1 percent increase in personal income from 1970 levels. Probably the largest regional effect within the biome would be in the southern grassland area of New Mexico where livestock earnings could be expected to increase by over 10 percent and

Table III-4: Estimated Income Effects of Proposed Action By Biome and Livestock Region

Biome and Livestock Regions	NRL AUMs (1970) (1,000's)	Addt'l NRL AUMs (1,000's)	Est. Ann Direct Income Eff. $1,000's	Livestock Industry Income Multiplier d/	Est. Total Ann. Income Effect $1,000's
Grassland Biome:					
N.W. Prairie	146	52	295	1.428	421
Calif. Central Valley	42	5	33	1.096	36
Spring Wheat (NE Mont.)	459	311	734	1.426	1,118
Montana Great Plain	764	528	1,538	1.789	2,751
Wyoming Great Plain	386	82	199	1.512	301
Colorado Great Plain	4	1	c/	1.722	c/
New Mexico Great Plain	152	73	285	1.536	438
Southern Grassland	1,446	779	4,510	1.443	6,508
Sub Total a/	3,400	1,830	7,600		11,600
Desert Biome b/:					
Snake River	669	158	722	1.562	1,128
Cold Desert (G. Basin)	4,233	680	1,821	1.537	2,799
Cold Desert (Central)	810	105	260	1.447	376
Cold Desert (Wyoming)	1,615	277	742	1.654	1,227
Hot Desert	624	60	605	1.931	1,168
Sub Total a/	7,950	1,280	4,150		6,700
Woodland-Bushland (Part):					
Calif. Central Coast	22	c/	c/	1.003	c/
Calif. Southern Coast	3	c/	c/	1.001	c/
Sub Total a/	25	c/	c/		c/
Coniferous Forest:					
N.W. Forest	19	2	c/	1.002	c/
Sierra Range	21	4	17	1.630	28
Ariz./N.M. Mtns.	236	117	264	1.337	364
Colo./N.M. Mtns.	613	110	343	1.749	600
Utah Mtns.	64	5	24	1.670	40
Mont./Wyom. Mtns.	304	86	265	1.699	450
Idaho/Ore. Mtns.	100	33	180	1.595	287
Sub Total a/	1,360	358	1,100		1,800
GRAND TOTAL a/	12,700	3,500	13,000		20,000

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a/ May not add due to rounding.
b/ Includes approximately 30 million acres of woodland-bushland.
c/ Too small to estimate.
d/ Source: Bureau of Land Management's Economic Activity Analysis Model.

personal income by 0.7 percent. This region exhibited a less than one percent population decline between 1960 and 1970 and the income effect of the proposed action may be sufficient to stabilize the population level, but not to provide a growth base.

The result of the proposal in the regions of the desert biome is expected to increase the AUMs on NRL by about 1,280,000 to a total of 9,230,000. The increased feed is estimated to raise annual earnings in the livestock industry by $4,150,000. When the multiplier effects in the regional economies are included (see Table III-1), the total effect on annual personal income flows in the biome is estimated at $6,700,000. These figures represent only a 1.2 percent increase in livestock earnings and less than one percent increase in personal income from 1970 levels. Probably the largest regional effect would be in the Great Basin portion of the biome, where livestock earnings could be expected to increase by slightly over three percent and personal incomes by less than one-tenth of one percent. This region experienced a 21-percent increase in population between 1960 and 1970 although the rural population declined by two percent. The income effects of the proposed action, having its major impact in rural areas, may tend to slow the rural-urban migration, but is only one-fifth of what would be needed to reverse the trend of the last decade.

The majority of acreage in the woodland-bushland biome was included in the desert biome as a necessary condition of relating the proposed action to regional economies. The only areas of this biome which could be separated into economic units were the California coastal areas, south of San Francisco. The livestock sector of these regional economies is relatively small and NRL provide small amounts of livestock feed.

Therefore, the proposed action is expected to have essentially no impact in the California regional economies.

The result of the action in the forest biome is expected to increase the AUMs on NRL by about 360,000 to a total of 1,718,000. The increased feed is estimated to raise annual earnings in the livestock industry by only $1,100,000 when multiplier effects in regional economies are included (see Table III-1); the total effect on annual personal income flows in the biome is estimated at $1,800,000. These figures represent about 0.6-percent increase in livestock earnings and an imperceptible increase in total personal income from 1970 levels. Probably the largest regional effect in the forest biome would be in the Arizona-New Mexico mountain region where livestock earnings could be expected to increase over four percent and personal income by about 0.2 percent. This region experienced a 15-percent increase in population between 1960 and 1970, lower than the western states' average of 24 percent. However, the rural population increased 13 percent over the same period rather than declining at the western average of five percent; 58 percent of the total 1970 population of the region is classified as rural. The estimated personal income effect could quite likely sustain another two to three percent increase in the rural population over 1970 levels.

Table III-1 contains a summary of income effects in all biomes as well as the cumulative effect in all western states. The reader is reminded that all income effects are the estimates of the incremental effects of the proposed action as it reflects change from the situation prevailing in 1970.

In summary, implementation of the proposal will require increased efforts in management of livestock and land resources, and perhaps greater investments in supportive facilities, by the livestock operator authorized to graze NRL. On the other hand, improved vegetative resources and better forage production will provide economic benefits to the individual, community, and region. Production of meat will increase to help meet the increasing demand.

Ecological Interrelationships

Impacts from Livestock Management Actions

For the purpose of this statement, land use and hazards were considered as part of the ecological interrelationships.

Removal of livestock from specific areas provides more vigorous productive vegetation for soil protection and permits direct cycling of minerals without passing through the domestic animal. Removal will also be beneficial to campers, rockhounds, vehicle operators, and other recreationists where there would otherwise be a conflict. Wildfire will become more prevalent and hazardous to structures, people, and wildlife.

Reducing animal numbers will have similar effects to a lesser degree. Either action, removal or reduction, could adversely affect individual ranching operations. Reducing numbers may eliminate serious competition with wildlife, wild horses and burros, and recreationists.

The increase of livestock numbers on certain areas may have an adverse impact on recreation land uses (ORV use areas, developed campsites, primitive areas, along trails and in wild and scenic river corridors).

Removal may be necessary from areas identified in the planning system. However, the buildup of fuel as a result of removal could cause more frequent and damaging wildfires.

Changing season of use to accommodate recreationists may cause some hardship to individual livestock operators. Livestock use around a fenced campground would not affect recreation use provided it did not occur during heavy recreation use seasons. If livestock use is changed to coincide with a period of heavy recreation use, its impact could be severe and would be similar to impacts incurred with an increase in animal numbers.

By changing the frequency of use of the land by livestock, impacts would be similar to changing seasons of use. If the frequency of use was lessened, the impact could be beneficial on all areas of recreation use. Animals would not be in recreation areas as often, thereby reducing conflicts. If frequency were increased, though, the amount of adverse impacts could increase. For example, ORV uses could be competing with livestock more frequently throughout the year.

If the livestock use of an area was deferred until after the recreation season, the impact would be beneficial. Although of minor importance, fewer vehicle accidents involving livestock would occur. Recreation users would have less disturbance by grazing animals. Odors and health hazards associated with livestock around campgrounds and other recreation sites would be minimized. The opposite could be true if deferment caused use of the area during the recreation season. With rotation of livestock, depending on when the area is used, the same impacts result.

Increasing livestock numbers could be beneficial to individual livestock operators. However, the increase may necessitate acquiring more private land and raising additional hay or cultivated crops to feed the larger animal numbers during periods when they do not graze NRL.

Deferment, rest, and rotation of grazing use results in the long run in more productive livestock and in healthy stands of perennial vegetation. This forms a protective soil mantle and a penetrating spreading root system that effectively protects soil from damage caused by raindrop impacts, intensive rainstorms, and wind. Accelerated erosive processes are minimized reducing overland flow, sedimentation, and salinity of streams and reservoirs. Vegetative material not consumed falls to the soil surface as litter, adding soil protection, and is eventually incorporated into the soil as humus, maintaining soil fertility. Humus supports bacterial life, enriches the soil, increases moisture absorption and retention, and reduces runoff and erosion.

Impacts from Supportive Measures

Fence construction can affect soils, vegetation and animals, as has been discussed in other sections. In addition, these may also cause changes in wind movement and snow accumulation, particularly where "tumble" weeds may pile up against a fence and significantly alter the temperature and moisture conditions in the microclimate.

Development of water facilities (pipelines, wells, springs, reservoirs, etc.) provide for better distribution of livestock, additional water sources for wildlife (including birds), and for recreation use. Properly designed water developments with sufficient capacity may be stocked with fish for recreation purposes and, with proper management of grazing, provide desirable habitat for waterfowl production (13). Water developments could also act as a focal point for attraction of wildlife thereby increasing viewing opportunities (see Figure III-13).

Vegetation manipulation by mechanical means involves practices which adversely affect soil by disturbing the soil surface and removing vegetative cover. Runoff and sediments may increase in some cases until new plants occupy the site. Mechanical means such as root plows, which disturb the surface as well as the subsurface, provide better water infiltration as well as elimination of competition. Chaining of vegetation, such as pinon-juniper, which leaves debris scattered over the landscape is aesthetically displeasing and restricts movement of big game and livestock. If the debris is piled and burned, air pollution is increased and watershed cover is destroyed,,but nutrient cycling is accelerated. Manipulative practices, particularly brush beating and chaining, leave a mulch on the soil surface. This aids in protection against erosion processes and provides protective cover to small mammals and birds.

Chemical spraying to eliminate poisonous plants or brush benefits grass growth by eliminating competition. Commonly some herbaceous broadleaf forbs (which comprise an important component of wildlife feed) are also destroyed. Spray may drift into adjacent lands and damage other crops or shade trees. Residues from the chemical may be washed into water bodies, damaging aquatic vegetation and fish.

Fire has historically been a natural force in the ecosystem resulting in maintaining an ecological balance. Controlled burning has the same effect, e.g., eliminating brush and other woody species and increasing

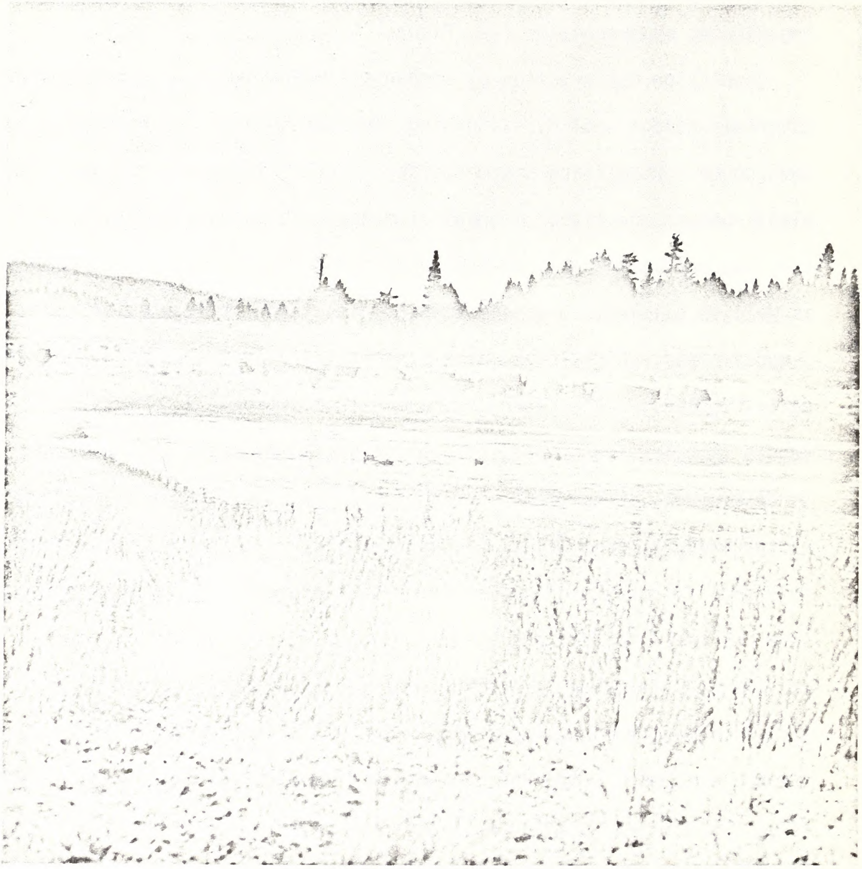

Figure III-13. Livestock reservoir with both cattle and waterfowl use in a rotation grazing system.

nutrient cycling. However, fire results in air pollution, may destroy wildlife habitat, and denudes the watershed temporarily. Perennial grass species may not be seriously damaged by fire and will begin immediate recovery if moisture is available.

Chemical compounds contained in pesticides may have immediate and long term impacts. The impact from insect control has been beneficial on vegetation where insecticides have been used to control an invasion of grasshoppers or other insects, but removing the organism from the ecosystem may disrupt food chains. Herbicides have been successfully used to control the invasion of brush species into grasslands. Benefits have been realized from these programs through soil stabilization, improved water quality, and forage increases for livestock and wildlife. Some pesticides, although banned by Executive Order No. 11643, have disrupted natural food chains and have been detrimental to wildlife, e.g., effect of DDT on egg shells of Peregrine falcons (26).

Roads and trails can have effects on many animal species of the environment. They may be beneficial to some recreationists and the livestock operator by making remote areas more accessible.

Adverse impacts can also occur where livestock are trailed when soils or plant growth conditions are most subject to damage from concentrated trampling and use. Water pollution, erosion, and increased sedimentation can occur where trail routes are improperly located.

Predators at times adversely affect livestock operations by killing sheep and cattle. A reduction of predators through control measures is beneficial to livestock and the livestock operator under these circumstances. Past control measures included methods which frequently were non-selective and resulted in the death of nontarget species. The adverse impact from the loss of nontarget species prompted the implementation of more selective control measures on natural resource lands directed by Executive Order 11643.[4/]

Line cabins and sheep camps occur on national resource lands and are a pleasant reminder of the "Old West" to many users.

Trucking and trailing of livestock during seasons of heavy recreation use could be adverse to the recreationist. However, many recreationists enjoy seeing sheep and cattle herds trailing along roads. This trailing could interfere with and be hazardous to vehicular traffic, especially when trailing occurs inside highway rights-of-way.

Obtaining better distribution of grazing use involves such actions as fencing, trailing, herding, developing additional water, placement of salt, etc. Uniform utilization throughout the grazing area relieves grazing pressure near streams and reservoirs and other areas of concentration. A beneficial impact can be obtained by controlling distribution of livestock to prevent large numbers in ORV use areas, campgrounds, along trails, in scenic areas and river corridors. This technique properly applied would lessen conflicts between recreationists and grazing animals.

Construction of fences provides better management and control of livestock. However, the fence will have the adverse impact of disrupting natural movements and migration of wildlife, destroying the illusion of "wide open space," limiting access by recreationists, and interfering with ORV use. Although minor, fences are a safety hazard during electrical storms and have caused injury and death to snowmobile and other ORV users.

[4/] E.O. 11643, February 8, 1972. Environmental Safeguards on Activities for Animal Damage Control on Federal Lands.

Construction of wells occasionally involves erecting a tower (windmill) which may be an aesthetic intrusion on the landscape.

Construction of roads and trails for livestock grazing management also provides better access for hunting, fishing, recreational sightseers, and for fire protection. The short-term effect of vegetative manipulation on recreation land use can be adverse. The long term effect is probably beneficial as it provides additional opportunities for hunting or viewing of wildlife and provides a more pleasing landscape.

Aesthetics

Impacts from Livestock Management Actions

Aesthetic values are derived by how people perceive the environment and are regulated by form, shape, color, texture, composition, lines, etc. Actions that produce a visible change in any of these elements of the natural environment can cause pleasant or adverse human reaction. Basic elements of landscape character can be effected in three ways:

1. Vegetation can be removed or changed.
2. The soil can be moved or rearranged.
3. A structure can be placed on the landscape.

The degree to which any of these three actions takes place determines how great an effect the action has on the natural environment.

Grazing management actions can result in either adverse or beneficial impacts, depending on the action taken. In some situations, additional livestock numbers may be permitted to graze without adverse impacts on aesthetics. If livestock numbers are reduced, vegetation will improve, soils will tend to stabilize and additional grazing-related structures may not be required on the landscape.

Impacts from Supportive Measures

Supportive measures related to grazing management may result in a beneficial or adverse impact to the aesthetic values of the landscape. Access roads, fencing, pond development, pipelines, and storage tank pads all impact the landscape. Because both vegetation and soil are disturbed, there is a potential for long term impact on all biomes.

The adverse visual impacts of the grazing program are partially offset by some benefits. Sometimes access roads open up an impressive scenic vista. Vegetative manipulation might result in forage production that attracts wildlife which can be viewed by the general public. Development of bodies of water could add to aesthetic values.

The manipulation of vegetation may cause a change in the natural environment that can be seen for great distances. Because of the lack of high vegetation and the low relief profile, it is possible to see considerable distances in the grasslands. This makes any surface disturbance quite obvious over a wide area. The lack of vertical elements in the natural landscape makes any man-made structures inordinately obvious.

Desert landforms, although similar to the grasslands in much of the area, are steeper and higher in many areas. Because of this steeper terrain, many of the operations involving the movement of earth will create a more obvious scar and will be visible for greater distances.

The texture of the vegetation in the cold desert, while similar in many respects to the grasslands, takes much longer to recover to its natural condition. Although the texture differs in the hot desert, recovery involves even longer periods of time. The lines created by roads, trails, fences, vegetative manipulation, pipelines, and powerlines will be more visible in the desert for a much longer time (see Figure III-14).

In many areas of the desert, the color of the surface of the soil and rocks is the result of long years of weathering and chemical interactions. When this surface color is disturbed, it is impossible to restore and it may take hundreds of years to recover naturally.

Most of the impacts in the woodland-bushland communities would be very much the same as those in the desert (see Figure III-15). In some areas the impacts may be more obvious because of the density of the vegetation, but may recover somewhat quicker. The density of the vegetation might also reduce the visual impact to some degree by restricting the viewing area.

The steepness of the terrain, along with the high relief profile in the coniferous forest, makes fence lines, pipelines and roads running perpendicular to the slope visible for extremely long distances. Clearing the vegetation also opens the slopes up to an erosion process that can soon strip the shallow soils and remove any chance of recovery of the vegetation. The steep slopes also make larger cuts and fills necessary for the construction of roads and storage tanks.

A landscape cover of grasses, forbs, shrubs, and trees is more pleasing than one of bare soils, gullies, and a monoculture or sparsity of vegetation. To many individuals, a herd of livestock grazing on healthy vegetation provides a scene of pastoral peacefulness and is a pleasant experience.

In summary, management of livestock grazing will result in an aesthetically more pleasing landscape by providing improved vegetative cover and composition.

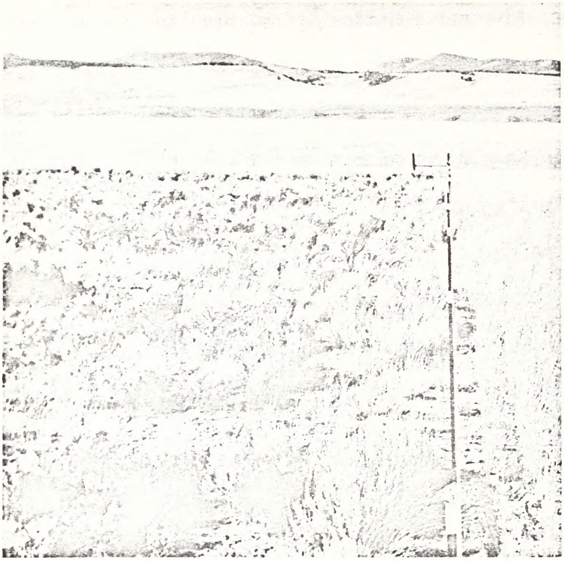

Figure III-14.

Lines caused by vegetative manipulation in the cold desert.

Figure III-15.

Reduced aesthetics in the woodland-bushland biome from vegetative manipulation.

Supportive measures, such as roads, pipelines, fences, etc., can affect a scenic view if not properly designed and located. Roads, however, may make impressive scenic features more accessible and some water developments could add to aesthetic values. Vegetative manipulation practices and soil disturbance can be fairly obvious in certain biomes. Such projects can be designed and located to blend with the natural terrain and may provide a pleasing scenic view if it breaks up monotonous stands of sagebrush, pinon-juniper, etc. Man-made structures, changing the texture of vegetation, color of surface soil, and lines created by fences, pipelines, vegetation treatment, etc., would all visually impact aesthetic values.

Human Interest Values

Impacts from Livestock Management Actions

All management actions will attempt to minimize impacts on human interest values. Consideration will be given to maintenance and protection of historical, geological and archeological features and values as previously discussed.

Impacts from Supportive Measures

Geological values are susceptible to alteration and destruction as a result of development that can destroy or impair their value as human interest subjects. Activities using explosives, such as road building or well development, in the vicinity of delicate geological features can destroy or impair their interpretive value. Activities involving earth moving can produce similar effects on unique geologic features.

Placing of development structures near geological features of interest tends to detract from their value for viewing and interpretive purposes.

Some types of geological phenomena such as fossils are susceptible to collection and removal, even though it is illegal to do so. Increased accessibility as a result of access roads and trails for livestock management could contribute to removal or vandalism of the values.

Archeological sites are most valuable to both the scientist and the sightseer when they are undisturbed. Excavation, earth movement, or soil compaction in and about an archeological site will reduce or destroy the values the site contains. One impact is providing access which can result in vandalism by human beings who destroy their own heritage by looting prehistoric sites for souvenirs and mementos.

In the past, many roads and trails constructed on federal lands for livestock grazing have decimated prehistoric remains. This is a potential impact in practically all areas from operations which involve excavation or soil disturbance. Trampling by livestock compacts the soil, which disturbs the stratigraphy and crushes artifacts within the soil. Activities at some distance from archeological sites may trigger erosion which will either destroy the site or cover it with debris. The incongruities of modern things in a prehistoric setting may tend to upset a visitor and subtract from the quality of his visit.

Impact of a livestock program can be detrimental to historical values if the activities are on or near historical sites and structures. Both the historical research values and the sightseeing recreation value can be destroyed by certain activities. Any type of excavation, earth movement or soil compaction in and about historical places can reduce or destroy the values the site contains. Many historic sites have potential for research using the archeological techniques and these areas should be treated as archeological sites. Heavy equipment can cut up old trails, destroying any feeling of their being historic and damaging any research value they may have.

New roads, trails and other disturbance on or near historic sites and buildings can destroy or damage the historic scene by introducing modern elements foreign to the historic period. This detracts from the understanding and feeling the visitor obtains. Introduction of humans and making areas with historical values more accessible increases the possibility of vandalism.

There are two basic items concerned with impact on cultural values: (a) impact on specific sites, and (b) the impact on the life style of a cultural group. Many native and introduced cultures in the country have areas or sites of religious, mythological, historical, symbolic, sentimental, or even imagined significance to them and their way of life. These sites and areas should be handled as archeological and historical sites for purposes of impact evaluation and mitigation.

Impact on life styles is difficult to assess for much of it is psychological and the values under impact are judgment values.

In brief, human interest values will not be seriously affected by the proposed management program except in construction activities and locations of certain supportive measures. Construction activities may destroy or impair unknown human interest values. Roads will provide better access to archeological and historical sites but may also result in increased vandalism.

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PART IV

MITIGATING MEASURES

Introduction

The mitigating measures described in this section are available through existing regulations and legislation for application to the livestock grazing management proposal. The degree to which any of the measures can be implemented is dependent upon public support and resulting organizational capability in terms of funds and manpower.

In discussing mitigating measures by environmental component, duplication occurs, i.e., the measures to reduce impact on soil also reduce impact on vegetation, recreation land use, aesthetics, etc. In order to eliminate duplication, mitigating measures will be discussed for each major item of the proposal. Their effect in reducing the impact on each environmental component will be discussed briefly.

Mitigation of Management Actions

The management actions included as part of the proposal will be applied where appropriate to achieve management objectives and to eliminate or reduce the adverse impact of grazing on other uses and the environment. The measures to be applied will be based on the management decisions made through the processes of the Bureau planning system. None of these measures will be used unless they are needed to accomplish management decisions and benefit the environment or some resource use. They will not be applied in situations which create a significant conflict with other uses or degrade the environment.

Livestock grazing use will be curtailed or eliminated on frail soils (soils which are easily disturbed) and soils where compaction may persist for relatively long periods of time resulting in overland flow and erosion. Such management action would be appropriate on important watershed drainages, especially where salinity is a serious problem. Improved vegetative cover and additional litter and soil humus resulting from rest, deferment, etc., partially reduces compaction and such soils will recover more quickly than where humus is minimal. Increased vegetative cover, litter, and humus resulting from proper management can materially reduce erosion.

Improved distribution of livestock over the land area will result in a more uniform distribution of solid and liquid wastes and dissipation of animal odor. Where needed to achieve management objectives, livestock will be removed or excluded from aquatic habitat by fencing. Exclusion of livestock will be made where necessary to eliminate impacts on high value recreation sites, critical wildlife habitat, historical sites, etc. Where possible, the rotation sequence will be timed so that livestock are not grazing in a recreation area during peak recreation use or in wildlife habitat critical for life processes.

Selective grazing of preferred plants and plant parts to the detriment of forage species will be partially mitigated by grazing systems confining the animals to smaller pastures, thus forcing utilization of other less preferred plants.

In some areas of the grassland and desert biomes, the probability of drought is not unusual. The grazing system design in these areas will consider the common occurrence of drought and appropriate livestock management actions will be taken to mitigate adverse impact to the vegetative cover and soil during drought. Management criteria would include flexible herd composition (cows and calves vs. steers), reduced stocking rate and utilization, nonuse in years of marginal forage production, and increased use in years of excess forage production.

When cattle are removed from an area, the impact on the livestock operator could be mitigated by providing forage in another area. The impact of increased fire hazard resulting from ungrazed forage can be mitigated by: (a) short-term leases at the option of the resource manager, and (b) contract or hiring of grazing when needed to remove potentially flammable vegetation.

Mitigation of Supportive Measures

Fences

1. Clearing right-of-way with heavy equipment is not permitted under present Bureau policy. This has reduced impact on soils, vegetation, wildlife habitat, and aesthetics.

2. Construction of fences across known migration routes of wildlife, wild horses or burros will be avoided to reduce the impact on animal migration.

3. Fencing specifications will be designed to minimize interference with movement of wild animals.

4. Fences will be designed, located, and constructed to minimum BLM specifications necessary to control livestock.

5. Except for pole and block, or other specially designed fences, fence posts will be used which blend with the landscape to reduce aesthetic impact unless safety hazards are involved as in ORV use areas.

6. Adequate gates and other passageways through fenced areas will be provided for recreationists, especially ORV users, to reduce impediment to recreation user.

7. In areas of heavy snowmobile use, fences will be constructed with lay-down panels.

8. Archeological surveys will be conducted along proposed fence lines to avoid impact on these human interest values. Known and potential historical, geological, and archeological sites will be avoided.

9. Where wooden posts and stays are used in fence construction, fences will be grounded to reduce hazards from electrical storms and broken powerlines.

Corrals

Few corrals are constructed on NRL. They will be located and constructed to blend in with the natural landscape to minimize the impact on aesthetics. Use of portable corrals will be encouraged. Corrals will not be constructed in areas with known or suspected archeological values, or in areas of high scenic value.

Water Developments

1. All developments will be located and constructed to blend in with the natural environment to reduce the impact on aesthetics.

2. A harmonious color will be used for all structures to minimize aesthetic impact.

3. Potentially suitable areas disturbed by construction will be reseeded with a mixture of vegetative species to minimize impact on soil, water quality, vegetation, wildlife habitat, and aesthetics.

4. Where feasible, all pipelines will be buried to reduce impact on aesthetics. Methods which least disturb the surface will be utilized and reseeding done with native species.

5. Archeological investigations will be conducted of all proposed development sites to avoid impacting these human interest values.

6. Development of water on or near significant geological, historical, or archeological sites will be avoided.

7. All waters will be provided with devices for wildlife and wild horse and burro use. Where water quality permits and a need exists, water developments will also provide for human use.

8. Provision will be made for partial livestock exclosures on ponds or reservoirs to increase wildlife habitat and impede sedimentation and salinization.

9. If a windmill tower would create an adverse aesthetic impact and another power source is available, the installation of a submersible or low profile pump will be considered.

Roads and Trails

1. Right-of-way clearing will be kept to a minimum to reduce impact on soil, vegetation, wildlife habitat, and aesthetics. The road or trail will be constructed to the minimum standards necessary to serve the intended purpose.

2. Adequate drainage will be included during road construction to minimize impact on soil, erosion, and water quality.

3. Suitable disturbed areas will be reseeded with a mixture of native species to minimize impact on vegetation, soil, water quality, wildlife habitat, and aesthetics.

4. When no longer needed, roads and trails will be rehabilitated to as near natural conditions as possible.

5. Construction through critical wildlife breeding and nesting areas will be avoided. Construction in areas where noise from vehicles and equipment interferes with lambing, calving, foaling etc., will be delayed.

6. Roads and trails will be located so as to conform to the landscape as much as possible, minimizing cuts and fills, to reduce impact on soil erosion, water quality, and aesthetics.

7. If a serious dust problem exists, road surfaces will be treated where practical to reduce air pollution or safety hazards.

8. Archeological investigations along all proposed routes prior to road construction will be conducted.

9. Where possible, roads and trails will be located away from geographical, historical, and archeological values to minimize impact on these human interest values.

Vegetative Manipulation

1. Archeological investigations will be conducted prior to vegetative manipulation.

2. Provision will be made for design or review of all vegetative manipulative treatment proposals by a multidisciplinary team, including a landscape architect.

3. In scenic areas, manipulation will be kept to a minimum and buffer strips of undisturbed vegetation will be retained. In the middle and foreground of scenic areas, straight edges and geometric shapes will be avoided.

4. Use of fire and chemicals will be controlled to minimize the impact on vegetation outside of the treatment area. Contracts will include consideration of atmospheric conditions, method and time of application, etc.

5. A buffer strip of vegetation will be retained along all streams to maintain water temperature, protect aquatic habitat, and reduce chance of water pollution.

6. In seedings, vegetation species will be provided for wildlife and wild horses and burros, if present.

7. Projects will be designed to leave untreated areas within the total treatment area for wildlife habitat and aesthetic values.

8. Only formulations of herbicides and chemicals approved by the Department of the Interior will be used.

9. Chemicals will be applied only when atmospheric conditions will minimize the possible drift onto croplands, water bodies, and other nontarget areas.

10. Mechanical treatments will be used only when slope, soil type, and method of treatment will result in a minimal or stabilized sediment production.

11. Livestock will be prohibited on the treatment areas until adequate ground cover is established.

12. Watering facilities such as open storage tanks, springs, drinking troughs, etc. will be protected from chemical sprays by covers.

13. Chemical plane flights over water will be prohibited to reduce potential for water pollution.

14. Fire will be used only when there is adequate soil moisture at or near the surface so that the surface will remain as cool as possible.

15. Fire will be used only during periods when atmospheric conditions allow adequate mixing and dilution of the smoke.

16. Vegetative debris resulting from mechanical treatment which impedes animal movement will be crushed and windrowed, or burned.

17. Land treatment practices will be kept to a minimum in areas occupied by wild horses and burros. If treatments are necessary they will be accomplished on relatively small areas in any one year so that the impacts will be localized and not general over the entire area.

18. Mechanical vegetative treatments will be timed so as to minimize the amount of disturbance to wildlife.

19. Some trees will be retained throughout the treatment areas to provide shade and reduce impact on aesthetics.

Animal-Insect Control

1. Predator and rodent control will be conducted only under strict federal supervision to avoid any detrimental results such as the killing of nontarget species.

2. Animal-insect control will be prohibited in recreation sites or other areas of concentrated public use.

3. Placement of warning signs will be required in animal control areas.

4. Consistency of predator, rodent, and insect control with federal and state laws and regulations will be assured.

5. Use of poisonous substances with secondary poisoning characteristics will be prohibited.

6. Animal control will be permitted only on specific areas where significant damage to livestock or wildlife is occurring. No control will be undertaken solely for the purpose of keeping animal numbers within arbitrary limits.

7. Control in areas inhabited by threatened species of wildlife will be prohibited unless the control measures are of no danger to the threatened species.

8. Control by poisons will be prohibited where a potential exists to contaminate the food chain of other life forms.

Transportation of Livestock

1. Trucking of livestock will be restricted to recognized roads and truck trails.

2. Trailing will be allowed only where trucking is not practical.

3. Trailing, when allowed, will be controlled to minimize impact on streams, impoundments, critical wildlife habitat areas, frail soils, vegetation, and intensive recreation use areas.

4. Trailing will be prohibited on areas of known archeological and historical values.

PART V

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Non Living Components

Soil

1. Increased soil exposure may occur for short periods of time in a pasture being grazed.

2. Soil compaction will occur in grazed pastures.

3. Certain vegetative manipulation treatments, followed by excessive or high intensity rainfall, will result in an increase in erosion and sedimentation.

Water

1. Water quality (because of sedimentation) may be temporarily lowered during maintenance of reservoirs, development of springs, and construction in flowing streams.

2. A possibility of failure to establish an adequate ground cover by seeding on construction sites exists in areas where soil or moisture conditions are unfavorable.

3. New livestock concentration areas will occur as a result of water development with some loss of water quality at those sites during the grazing treatment.

4. Sediment production will be increased during road construction even though partially mitigated by road grade, side slopes and other design features.

5. Water quality will be affected by the sediment production resulting from road and trail surface runoff.

Air

1. Minor local air pollution may result during reservoir construction due to dust.

2. Dust will reduce local air quality during road construction and vehicular use.

3. Air quality will be affected to some degree from vehicle emissions on NRL roads and trails.

4. Air quality will be locally affected by dust particulate matter while mechanical vegetative manipulation is in progress.

5. Some local air pollution will occur from smoke and particulate matter arising from fires used as a vegetative manipulation technique.

Living Components

Vegetation

1. Vegetation will be destroyed and soil surface disturbed for the width and length of newly constructed roads or trails during the life of the project.

2. Short term contamination of soil, vegetation, and air will occur from chemicals used in vegetative manipulation.

3. Temporary reduction in vegetation productivity will occur within a burned area.

4. During vegetative manipulation by chemical spray, the hazard of chemical drift to non target areas will be present due to unexpected shifts in wind during application.

Animals

1. Livestock daily gains may be reduced temporarily due to movement from one area to another.

2. Noise from heavy equipment operations may disturb wildlife, wild horses, burros, and domestic livestock during road construction. Tranquility in remote areas will be interrupted.

3. Life cycles, nesting, breeding and other natural wildlife phenomena may be interrupted or altered during road construction and subsequent use.

4. Wildlife, wild horses, wild burros, and livestock will be subject to harrassment by vehicular traffic and humans using newly constructed roads and trails on NRL.

5. During mechanical vegetative manipulation, wildlife, wild horses and burros in the area will be temporarily disturbed.

6. During animal and insect control, some killing of non target species, although minimized, may still occur.

7. Animals which may add to the public's enjoyment may be temporarily reduced by animal and insect control measures.

8. Food chains of aquatic or terrestrial habitats important to non-target life forms may be adversely affected by some animal and insect control measures.

9. Livestock may incur temporary weight loss during transportation.

10. Livestock may suffer from sore hooves or respiratory disorders from dust associated with trailing.

11. Livestock being transported in vehicles may be subjected to excessive dust, abrupt changes in temperature, shipping fever, and injury from being confined in close quarters.

12. Changes in diet that may result from being trailed or transported may result in temporary alteration of physiological processes of livestock.

13. The noise and activity associated with trucking of domestic animals may disturb wildlife, wild horses, wild burros, and humans.

Human

1. Livestock operators will be required to increase their investment in time, money, and energy.

2. Where removal or reduction in numbers of livestock is the management action required, the individual operator will experience a reduction in personal income.

3. Implementation of the proposal will require additional investment of public funds.

Ecological Interrelationships

1. Although minimized, some degree of competition between livestock, wildlife, and wild horses and burros will occur in grazed pastures with all management actions except where livestock is removed.

2. Livestock excreta will be deposited on lands being grazed and in accessible waters.

3. Energy and minerals will be removed from the grazed pastures in the form of livestock products (meat, milk, wool, hides, etc.).

4. With increased vegetative production resulting from management actions, wildfires will become more prevalent.

5. Even though all of the latest design features are incorporated into fence construction, some adverse impacts will occur on certain species of wildlife, wild horses or wild burros. Younger animals will be particularly affected.

6. Hazards to ORVs will continue even though fences are well marked. Hazards to snowmobile operators may exist if let-down panels are not lowered prior to heavy snowfalls. Even though fences are grounded, a hazard may still exist from lightning or downed powerlines.

7. Fences will prevent unrestricted movement of ORVs.

8. Injury and death of some species of wildlife, livestock, and wild horses or burros can result if the animal becomes entangled in fence wire.

9. Some recreation uses will be temporarily interrupted in vegetation treatment areas.

10. Trucking of livestock may cause a safety hazard in heavy recreation use areas on roadways of common use.

Aesthetics

1. Fences may detract from the aesthetics of the natural scene, even though the design incorporates features and color to harmonize with the surrounding environment.

2. On some occasions, windmills, storage tanks, troughs, and pipelines will impact aesthetic values.

Human Interest Values

1. Some geological formations will be altered by construction of roads and trails.

2. Historic and archeological values may become more vulnerable to vandalism by construction of roads and trails.

PART VI

SHORT TERM USES VERSUS LONG TERM PRODUCTIVITY

The proposal involves managing the flow of renewable vegetative resources. Under the terms of the proposal and the mitigating measures which can be utilized, the short term use by livestock will not adversely affect the long term productivity of resource values from NRL. The proposal will enhance long term productivity and soil protection while still providing for optimum short term benefits consistent with a quality environment.

Short term use can be controlled at levels so as to utilize a flow of resource productivity which would otherwise be lost. As the productive capacity increases over time from management practices, short term use levels can be raised without damaging future capacity, although other impacts may occur as stated in Part III. The need for continued short term use is more fully explored in Appendix III-A under Demand Analysis.

The major objective of the proposal is to maintain and improve vegetative resources through management actions and supportive measures. Short term livestock grazing is managed to aid biological processes which will result in improved vegetative conditions and greater stability of soil. Over time under the proposed management, improved range conditions will result in an increased sustainable yield of livestock forage, an improved watershed stability, a more productive wildlife habitat, and enhancement of aesthetics.

One possible area where a reduction in long term productivity or benefits could occur is in the field of human interest values. Archeological sites or values could be overlooked in the process of obtaining short term benefits.

Long term values of the site can be severely diminished or lost if disturbed before being thoroughly examined and documented. Historical sites, which at present have not been studied or documented, could be destroyed creating a gap in the historical chain of man's existence. Unique ecological sites not yet known or examined could be harmed altering the long term benefits which could be derived from them if left undisturbed.

Full implementation of the proposal and strict adherence to the goals and objectives established under the planning system will result in minimal loss of long term archeological and historical values.

PART VII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Ecological, historical, geological or archeological values which may be inadvertently destroyed are irretrievable.

The human resources involved in implementing the proposal, in a sense, are irreversible and irretrievable. These resources could be applied to other programs on the NRL.

Most areas where supportive measures are applied or constructed can be rehabilitated as facilities are removed. The initial cost of those supportive measures are irretrievable.

PART VIII

ALTERNATIVES TO THE PROPOSED ACTION

Introduction

This section presents major viable alternatives to the proposed action varying from complete removal of domestic livestock from NRL to maximum livestock utilization of NRL. The impacts of each alternative are identified in a manner comparable to those of the proposed action. Three alternatives are described.

Alternative A--continue present program--is a commitment to management objectives constrained by existing funds and manpower. Full operation of the planning system is assured with regard to setting management objectives. The range management activity would be limited, however, to the present budget level ($6.7 million) plus any increases in the range improvement fund as established by present law and regulation.

Alternative B--no grazing--prohibit domestic livestock grazing as a multiple-use on NRL.

Alternative C--maximize livestock production--implies managing domestic livestock as the dominant use on the 140 million acres of grazable lands of the NRL. This level of management implies nonexploitive, nonexclusive sustained yield use of the NRL, but not full multiple-use consideration through the planning system.

The presentation of Alternatives B and C represents an extreme range of actions that could be taken under unusual circumstances, including appropriate legislative mandates. Though intended to be illustrative only, these alternatives have been advanced by documented expressions of interest.

Alternative A - Continue Present Program

Description of Alternative Action: This alternative would be to continue the present livestock grazing program as it has been conducted in the past decade with the present level of manpower and funding.

Existing AMPs on 25 million acres will be maintained. Needed revisions in AMPs to respond to changing resource conditions or correct deficiencies in implemented grazing systems will continue as time and funds permit. Relatively few AMPs will be implemented in the future to assist in resolving critical resource problems.

On the estimated 20 million acres not covered by AMPs but where present livestock grazing management is considered proper, the existing program will be maintained. On the estimated 88 million acres where management action is needed, all current administrative procedures will continue to be used. Management actions on these 88 million acres would result primarily in reduction in livestock numbers. Livestock numbers would tend to be reduced due to decisions occurring under the Bureau planning process. This reduction would probably be around five percent over the next 20 years.

On the other hand, increases in livestock numbers are likely to occur on grazing allotments to the upper limits of qualified demand until fair market value in grazing fees is reached in 1980. This situation can be controlled to the extent of range studies reflecting available livestock forage. Even upon implementation of the full grazing fee in 1980, there will be a tendency to maximize use to the extent of qualifications at the expense of over-obligating the rangeland resource because of the lack of study data and management capability.

More range improvement funds will be available as grazing fees increase. Range improvement funds will continue to be expended and investment of more private funds in range improvement projects will probably occur. Authorizations to develop range improvement projects will require environmental analysis and shall contain environmental stipulations for the livestock operator.

The status of livestock use on NRL in 1970 is shown on Table VIII-1 and no substantial change is expected under this alternative.

Table VIII-1: Operators, Livestock and Feed Use on National Resource Lands, 1970

State	Livestock Operators	No. Cattle & Horses	No. Sheep & Goats	Cattle & Horses AUMs	Sheep & Goats AUMs	Total b/ AUMs
Arizona	1,000	224,900	28,500	642,300	2,600	645,000
California	1,000	132,000	260,900	432,300	121,300	553,600
Colorado	2,100	330,400	724,900	468,800	216,000	684,800
Idaho	2,800	358,000	653,800	981,800	276,400	1,258,500
Montana	3,900	615,200	369,700	1,292,100	139,300	1,431,500
Nevada	900	356,000	406,400	1,682,700	353,400	2,036,100
New Mexico	2,900	264,300	211,600	1,696,100	280,300	1,976,400
Oregon a/	2,100	278,400	64,400	1,011,500	36,200	1,047,700
Utah	2,600	173,500	1,019,800	629,500	527,300	1,156,800
Wyoming	2,900	721,900	1,523,900	1,172,600	770,700	1,943,300
North Dakota	100	8,200	5,200	N/A	N/A	13,600
South Dakota	300	9,400	24,200	N/A	N/A	71,100
Nebraska	N/A	10,500	100	N/A	N/A	1,500
Total b/	23,000	3,484,000	5,617,000	10,010,000	2,724,000	12,820,000

a/ Includes State of Washington
b/ May not add due to rounding

Environmental Impacts of the Alternative Action

1. On land where improper management continues, adverse impacts on the vegetative resource will continue. Little or no improvement in range condition and trend can be expected. Where improper management is the present situation, plant vigor and forage production will remain low and continue to decline in some cases. Plants will be unable to produce seed for reproduction of the species.

2. Competition for forage with other grazing animals will continue on those areas where corrective management action is needed. Selective grazing and reduced vigor of preferred plant species will continue to result in the invasion by less desirable plants with consequent changes in associated fauna. Vegetative cover for soil protection will continue to decline resulting in soil erosion and sedimentation and salinization of water bodies and streams. As a result water quality will be reduced. Vegetative composition will continue to slowly change to more brush or annuals and poisonous plants on some allotments.

3. Effects of drought on plants in low vigor will continue to be accentuated because growth of root systems is restricted. Forage production, while fluctuating widely in response to annual climatic conditions, will generally decline over time.

4. Where overutilization is continuing and the vegetative resource is steadily deteriorating, stockmen will continue to feed maintenance hay and supplemental rations on the open range or seek alternative grazing lands to remain in business. Feeding maintenance hay and supplemental rations to livestock on open range has an adverse impact on vegetation on specific sites because livestock congregate and trample these areas.

5. The present program will not prevent concentrated livestock use of vegetation on certain favored locations. Excessive utilization of forage, soil trampling and disturbance by livestock in favored locations will continue to initiate gully erosion. The potential for topographic change by erosion through the effect of unmanaged livestock will continue to occur at an accelerated pace.

6. Excessive use of vegetation and improper seasons of use will continue on some of the national resource lands. Selective grazing habits of unmanaged livestock will cause a decline in the most palatable and desired plant species. Root systems will become less well developed. The depth and spread of roots will be restricted, thus limiting the volume of soil from which minerals and moisture can be absorbed. In these instances, roots will become less effective in binding the soil against forces of erosion and plants will become more susceptible to drought. Vegetative composition will continue to change toward plant species most tolerant to grazing pressure and more suitable to arid sites. Plant litter will be reduced and soil productivity impaired.

7. Deterioration and erosion of soils will continue on NRL where livestock are not properly managed on a system based on the physiological needs of plants and protection of soils. On some of the unmanaged lands accelerated erosion has destroyed a portion of the soil mantle. Destruction of plant cover has reduced the protective cover of herbaceous litter necessary for soil protection. Steep and erodable soil areas grazed by livestock will continue to deteriorate. Erodable stream banks will continue to be trampled.

8. Climate will not generally be effected but microclimates important to plant and animal life will be influenced.

9. Where overgrazing continues, cover for birds and small animals will be reduced. Removal of overhanging vegetative cover from streambanks or shorelines and emergent vegetation from aquatic habitats by livestock grazing will raise the water temperature, increase siltation and destroy important waterfowl nesting habitat. Fish habitat will become less productive where shoreline cover is reduced and water pollution continues or increases. Forbs and succulents required for wildlife reproduction and survival will be diminished by improper seasons of grazing. Food chains of small organisms will be diminished and ecological balance impaired. Threatened species of wildlife will be jeopardized where important habitats are not protected from overgrazing.

10. Continuation of the present program will continue to adversely affect domestic livestock on those allotments where grazing management is improper and the vegetative resource is depleted. Livestock will not receive adequate forage in some cases and consequently will continue to eat less desirable and poisonous plants. Under these circumstances, animals lose weight, do not breed properly, may abort their offspring, and disrupt their physiological functions.

Where continuous year-long grazing and overutilization is common, particularly in the southern grassland and desert biome, livestock do not attain their full growth potential.

Livestock reproduction and body condition will be impaired under the continuation of improper grazing management. Required adjustments in livestock numbers, distribution and changes in seasons of use will not occur to the extent necessary on these areas of the NRL. Lands will receive varying intensities of management more as the result of the livestock operator rather than of the resource manager. Overgrazing will continue damage to the ecosystem.

11. Competition of wild horses and burros for forage and water with domestic livestock and indigenous wildlife shall continue to increase. Improper livestock management reduces the land's capacity to provide a natural ecological balance as directed by legislation related to management and protection of wild horses and burros. Certain management actions, i.e., removal of domestic livestock, change in season of use, etc., will in some circumstances, have to be taken to accommodate wild horses and burros consistent with the recently enacted Wild Horse and Burro Act.[1/] Such actions will minimize competition for forage, water, and living space between wild horses and burros and domestic livestock.

12. A continuation of the current program on NRL can have serious implications on public attitudes. The Bureau of Land Management will not be accepted as an effective land management agency if it cannot prevent the continuing decline in productivity of these lands.

The science of range management will not be adequately applied. Land managers will have a less defendable role in allowing continued unmanaged grazing. The intent of the Taylor Grazing Act will not be met with respect to prevention of injury to the public lands. Requirements of the National Environmental Policy Act of 1969 will not be achieved.

[1/] Wild Horse and Burro Act of 1971; PL 92-195. DECEMBER 15, 1971.

13. Continuance of the present program is expected to result in a general five percent reduction of AUMs in all biomes and livestock regions over a 20-year period. Such reduction is estimated to have very small impact on the personal income levels of the 11 western states--in total only about $3 million annually. Even at regional levels this reduction could not be expected to reduce personal income levels by as much as one-tenth of one percent. Of course, individual income could be significantly affected as the 500,000 AUM reduction becomes reality on specific allotments. Whether the small adverse effects of this alternative on regional economies would contribute to the erosion of rural community economic structures is conjectural. This would be the case only if the income loss was absolute, that is, not offset by an alternative land use which could conceivably more than compensate for the income loss occurring in the livestock sector. A gradual five percent reduction of feed from NRL may also, overall, be easily compensated for by increased productivity on private lands. Therefore, the estimated impact on income may be more in the nature of opportunities foregone than actual losses.

14. On a portion of the land area where proper grazing management has not been applied, nutrient cycling will continue to be disrupted. This will take two forms primarily: (a) excessive removal of plant tissues and minerals from the site by grazing animals, and (b) minerals lost through erosion of soil resulting from improper livestock grazing. Soil organisms, essential to the mineral cycling process by incorporating organic material into the soil, will be altered to some degree by compaction of the soil, which prevents moisture infiltration, and by removal of vegetative cover

which exposes the surface to increased solar radiation. Animal concentration around favored locations (water, shade, etc.) results in concentrated wastes, perhaps beyond the capacity of the soil to assimilate. Animal wastes deposited or leached into water will disrupt nutrient cycling and fertility of streams and water bodies. In areas where water sources are limited to springs, small or intermittent streams, and small ponds, the contamination could be serious. In areas where the water supply is more plentiful, contamination would be nil.

Where livestock make primary use of the vegetative resource, leaving little for other life forms, the energy flow and food chain becomes relatively short, i.e., from primary producer to primary consumer. Other primary consumers (insects, small mammals) and secondary consumers (hawks, coyotes) are at least partially eliminated from the food chain.

Continuation of the present program will affect other land uses where improper grazing is practiced. Aesthetic quality of the landscape will be degraded as a result of vegetative denudation and erosion.

Invasion and spread of poisonous and other undesirable plants will continue on areas where livestock use is improperly managed.

15. The supportive measures discussed under Part III (Environmental Impacts of the Proposed Action) will have similar effects on the environment if the existing program is continued. These effects would be mitigated in the same manner as explained in Part IV (Mitigating Measures).

Alternative B - No Grazing

Description of Alternative Action: This alternative would prohibit livestock grazing on national resource lands. Repeal of the Taylor Grazing Act and other appropriate legislative authority and responsibility listed in Part I (Description of the Proposal) would be necessary.

Environmental Impacts of the Alternative Action

1. Livestock use of vegetation on national resource lands would cease. All adverse impacts of livestock use on soil, air, vegetation, water quality, aquatic habitat and plant density would improve if wildlife and wild horses and burros are held within reasonable limits. The extent that wildlife, wild horses and burros will fill the void of livestock as a component of the ecosystem is not known. The natural nutrient cycle would be restored. Plant succession would be interrupted only by wildfires, wildlife, wild horse and burro use. Sedimentation, salinization, and eutrophication of water caused by livestock grazing on NRL would cease.

2. Some restored forage and vegetative cover would be available for use by wildlife, wild horses and wild burros. Ecosystems would not be disturbed for the production of domestic animals.

3. Aquatic and shoreline vegetation would be less disturbed and provide improved habitat for wildlife forms, including fish.

4. Herbicides or other chemical applications to benefit production of livestock forage would terminate. Presently from 50,000 to 80,000 acres of NRL are treated annually for this purpose. Certain mechanical and chemical treatments may still be applied to benefit wildlife habitat and produce forage for wild horses and burros.

5. Animal control practices for protection of livestock would not be required. As a result predators and some threatened wildlife species would have an improved opportunity for survival.

6. Wildlife populations would increase when food, cover, and water are reserved for wildlife. Harvestable surpluses of wildlife will

contribute to the enjoyment of some outdoorsmen. The mortality of wildlife by starvation caused by competition with domestic livestock will be eliminated.

7. The source of domestic stock diseases and parasites transmittable to wildlife would be removed except from those livestock grazing private, state and other lands. Bighorn sheep and deer populations may respond favorably and extend their ranges to historic habitats.

8. Most livestock supportive features including fences, corrals, roads, trails, cattleguards, gates and line cabins could be removed. The impediments to free movement of indigenous wildlife as well as the public would be eliminated in areas of consolidated federal ownership where access across private lands is not restricted. Access across private lands however, could become more difficult.

9. Federal funds would not be required for maintenance of livestock facilities or administration of grazing. The funds previously expended for grazing administration could be redirected to other resource management programs.

10. Damage or loss of historical, geological or archeological values due to livestock grazing programs would be eliminated. Site investigation would not be necessary for either the grazing of livestock or its required support measures.

11. Income reduction by removal or suspension of all livestock grazing on NRL would have significant impacts on the western livestock industry and the regional economies which are dependent on this sector. While some offsetting adjustments could be expected within the industry and economic structures as a result of alternative land uses, there would be a definite

depressive economic effect during the period of adjustment and many individuals who are of older age would be permanently disenfranchised of their major source of income. The income effects mentioned here do not reflect any assumptions regarding countervailing adjustments.

Direct effects on livestock industry earnings is estimated at $45 million or four percent of the sector's annual earnings in all western states. Earnings in the grassland biome would be reduced about three percent, in the forest biome by about two percent and the greatest impact would be in the desert biome where livestock earnings would decrease 7.6 percent. If multiplier effects on regional economies were included, this alternative would result in a total annual reduction in personal income of about $72 million in the 11 western states, over half of which would be expected to occur in the desert biome.

Regional effects within biomes vary because of differing economic dependency on the livestock industry and the relative importance of NRL to the industry. The coastal regions of California in the woodland-bushland biome would essentially experience no impact. The largest absolute impact would occur in the Great Basin region of the desert biome where an $11.3 million reduction in livestock earnings would lead to a 0.6 percent reduction in regional personal income. However, the largest relative impact would probably be felt in the southern grassland region of Arizona and New Mexico. Here an $8.4 million reduction in livestock earnings represents 19.2 percent of the total regional earnings of this sector and could be expected to lead to an overall reduction in personal income of 1.4 percent. In this region, the personal income loss is equivalent to the per capita income of 5,000 persons or five percent of the rural population.

12. Energy in the form of vegetation that can sustain livestock and produce red meat will be lost to the extent of about 13 million animal unit months annually based on present use. The annual supply of some two million or more feeder calves and over four million feeder lambs to feedlots for fattening and marketing would be lost.

More efficient use of energy is a matter of high national priority. Fossil fuels (coal, oil and gas) to produce livestock feeds from cultivated lands is a significant expenditure of petroleum products. Large amounts of energy are consumed in the "supply sector" to provide the farmer and rancher with fertilizers, pesticides, machinery, and other inputs. Large amounts of energy are used in the "production sector" for planting, cultivation, irrigation, care, and harvesting of feed crops.

One aspect of energy flow of vital importance to livestock grazing is the capture, conservation, and utilization of energy produced by native vegetation. On rangelands, the ruminant animal, both domestic and wild, through its ability to convert roughage to edible meat, is the primary means of making productive use of these areas.

The fossil fuel consumption for livestock production on rangelands is relatively small compared to energy costs in more intensive operations. Tractors and machinery to produce feed grains, hay, silage, etc., utilize fossil fuel--a depletable resource. Livestock grazing on rangelands operates on solar energy--an infinite resource. One estimate indicates that over 10,000 carlories of fuel are required to capture 3,000 calories of food and place it before the consumer. 1/

1/ From a paper prepared by Thomas, Gerald W. 1973. Agriculture Faces the Energy Crisis. New Mexico State University.

13. Livestock operators dependent on NRL for year-round ranch operation would suffer severely by removal of livestock from NRL. The degree of dependency on NRL to support a year-round ranching operation varies from 12 months in some areas of the Southwest to a few months in the Rocky Mountains. It is doubtful that other grazing lands and forage resources could be obtained to support the livestock removed from NRL and thus, many rural ranching families would be forced out of business. Additional concentrated livestock use on private and other lands to compensate for removal from NRL would seriously deplete these lands and resources.

14. Operators would not contribute to or maintain livestock waters previously available to wildlife. This cost which represents several hundred thousand dollars annually would become the full responsibility of BLM or the State Wildlife Agency.

15. Livestock operations on private lands intermingled with federal ownership will be severely interrupted. Trespass of livestock on NRL would be inevitable and difficult to control.

16. Removal of livestock from all national resource lands including fragmented parcels located within other ownerships, would require extensive fence construction and maintenance. The impact of extensive fencing could be environmentally unacceptable.

17. Revenues previously received by the U.S. Treasury from grazing fees would not be available to supplement future management costs on NRL. This would represent a loss in excess of $3 million in range improvement funds for 1974.

18. Wildfires will become more prevalent as a result of accumulation of fuel. Additional federal expenditures may be required to control wildfire, prevent trespass by livestock, maintain and develop water for wildlife, wild horses and burros, and rehabilitate burned depleted areas.

19. Federal funds may be required to compensate private investment in range improvements now existing on NRL in the same manner as is now provided by existing regulations in the event of classification and disposition.

Alternative C - Maximize Livestock Production

Description of Alternative Action

This program would provide for livestock grazing as the dominant use on 140 million acres of NRL. It involves the maximum nonexploitive production and utilization of livestock forage. Allotment management plans would be implemented on 133 million acres of NRL. An additional seven million acres of isolated tracts of NRL would be managed for maximum nonexploitive production and utilization of livestock forage.

Many improvements (water, fencing, seeding, etc.) need to be implemented to maximize production and utilization. All other resources would be subordinated to livestock grazing on these areas. Supportive measures as described under the proposal (Part I) would be adopted on suitable areas.

Under this system, the amount of AUMs would be increased approximately 70 percent over present level of 13 million AUMs as projected in the PLLRC report of 1970. [1/]

[1/] United States Public Land Law Review Commission. One Third of the Nation's Land. U.S. Government Printing Office. 1970

Environmental Impacts of the Alternative Action

1. Major emphasis on maximizing vegetative cover for livestock forage will result in improved watershed conditions but may adversely impact wildlife because of changes in species competition.

2. Vegetative cover would be increased on potentially suitable sites by land treatment practices in the forms of plowing, drilling, fertilizing and seeding grass and other preferred livestock forage species. These may result in extensive exotic monocultures.

3. Critical watershed or wildlife habitats would have livestock completely removed until grazing areas were rehabilitated. This would reduce soil erosion and competition with wildlife.

4. Resource values such as recreation, wildlife, archeological, etc., would be relegated to secondary importance and be permitted only if compatible with livestock grazing.

5. Mechanical and chemical vegetative manipulation projects directed at improving vegetative cover for livestock would tend to stabilize soil and improve water quality. However, pollution of air and water could result from chemical spraying in land treatment projects such as sagebrush spraying. Under present restrictions for chemical and mechanical treatment projects, this pollution would be minimal.

6. Animal control programs (predators, rodents, insects) would be increased to minimize losses of livestock or livestock forage to maximize livestock production.

7. In areas of concentrated application residues of nitrates, phosphates, and other chemicals from fertilizer applied to maximize forage will be washed into streams resulting in reduced water quality through eutrophication and other chemical reactions. The results of this action could eliminate desirable fish species and other aquatic wildlife as well as increase public health hazards.

8. The public opportunities to enjoy multiple-use activities on NRL would be diminished because of the heavy emphasis on livestock grazing.

9. The quality of wildlife habitat would be lowered in many cases because of the conversion of native plant species to introduced vegetative species for primary use as livestock forage. Important bird nesting areas or winter browse species for big game animals could be eliminated by these conversions.

10. To secure full utilization of livestock forage produced on NRL, many livestock operators would have to purchase additional base lands or make other arrangements for their livestock when not using NRL.

11. The many fences required as a supportive measure would limit movement of wildlife, wild horses and wild burros on NRL.

12. Access to NRL would become more available as new roads and trails are developed for livestock grazing purposes; however, the impact of this alternative on recreation land use would be severe, because the landscape would contain large numbers of livestock and supportive facilities such as fences that would restrict use by recreationists. Increased livestock use would have an adverse effect on developed campsites, ORV use areas, primitive areas, and wild and scenic river corridors.

13. The impact on aesthetics to many people would be extreme where large areas of vegetation are altered and extensive vegetative conversions created that distract from the natural setting. The many structures needed to maximize livestock production would intrude on scenic landscapes. The potential for long term adverse impacts is increased with additional and continual vegetative manipulation. Livestock numbers would increase and become a common characteristic of the land. To some people this would be aesthetically pleasing, but to many of the sightseeing public it would be adverse as they would rather view wildlife or natural scenes.

14. Some historical, geological and archeological values would be destroyed by the increase in numbers of grazing animals and construction of supportive measures. The values which were not directly harmed would be subjected to increased human pressure resulting from improved access which would be required under this alternative.

15. Conflicts between wildlife and livestock would increase on some areas since the forage resource would be devoted to livestock production.

16. The better forage conditions and supportive measures would improve livestock condition and production.

17. Livestock numbers would be increased thereby making more offspring available for feedlots or direct slaughter.

18. Increased water developments for livestock would be beneficial to wildlife, wild horses and burros in the area.

19. Economic benefits would accrue to the individual rancher and to the economy as a whole.

Unlike the other alternatives and the proposed action, the income analysis of this alternative includes total impacts rather than just the incremental change from the present situation. This is because alternative "C" represents a nonexploitive economic development alternative; therefore, the total cumulative economic impacts are appropriate. Maximum output is estimated at about 70 percent increase in AUMs.

The direct effects on livestock industry earnings are estimated at $73 million or about seven percent of the sector's annual earnings in all western states. Earnings related to NRL use in the grassland biome would also account for about six percent of the livestock earnings of the biome; only about 3.5 percent of the livestock earnings of the forest biome would be related to NRL use. The largest absolute and relative impact on incomes could be expected in the desert biome where $35.7 million of earnings represents 10 percent of the total livestock industry earnings. If multiplier effects on regional economies were included, about $58.4 million of personal income in the desert biome could be associated with maximum livestock grazing on NRL and about $115 million associated with the program over all 11 western states.

As with other alternatives, regional income effects vary within and between biomes as a result of differing economic dependency on the livestock industry and the relative importance of NRL to the industry. See Appendix III-A for reference to income effects of this alternative as well as others by biome and regions within biomes. The largest regional impact on income would probably occur in the southern grassland regions of Arizona and New Mexico. In this region the $17.8 million of earnings related to NRL grazing at maximum development could be associated with about $25.7 million of personal income (including multiplier effects) or the equivalent of the per capita income of 10.6 thousand persons or three percent of the total 1970 population of the region.

PART IX

COOPERATION AND COORDINATION WITH OTHERS

The Bureau of Land Management completed a preliminary working draft of the Livestock Grazing Environmental Impact Statement in March 1973. During the preparation of that draft, consultations were held with representatives of user groups, professional societies, conservation organizations, the academic community and federal and state land management agencies. In addition to selected individuals, a copy of the preliminary draft was sent to the following for review:

Federal Agencies

Soil Conservation Service

Forest Service

Bureau of Sport Fisheries and Wildlife

Bureau of Indian Affairs

Bureau of Land Management State Offices: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming.

State Agencies

Utah State University
College of Natural Resources

Colorado State University
Range Science Department

University of Arizona
College of Agriculture
Department of Watershed Management

Private Groups

National Wool Growers Association

American National Cattlemen's Association

National Wildlife Federation

Society for Range Management

Natural Resources Defense Council, Inc.

The comments received were then circulated among the reviewers and the team preparing the report and some additional comments and suggestions were received. These were considered in the preparation of this draft statement. Some discussions relating to the preparation of the statement were held with members of Congressional staffs.

The statement was developed by a team of BLM employees with professional backgrounds in range management, watershed management, wildlife, forestry, recreation, minerals, economics, and land use planning.

During the development of this statement, consultation continued with groups and individuals.

GLOSSARY OF WORDS AND PHRASES USED IN THIS ENVIRONMENTAL IMPACT STATEMENT

Adjustments in Numbers - Change (increase or decrease) of livestock numbers to conform to the amount of forage produced in an area, considering other multiple uses.

Adventitious Growth - Vegetative growth originating from plant parts not normally producing growth.

Algae Bloom - An abundant growth of plankton algae during hot weather that turns the water green and perhaps toxic.

Allotment - An area of land where one or more individuals graze their livestock. It generally consists of national resource lands but may include parcels of private or state owned lands. The number of livestock and season of use are stipulated for each allotment. An allotment may consist of several pastures or be only one pasture.

Allotment Management Plan (AMP) - A concisely written program of livestock grazing management, including supportive measures, if required, designed to attain specific management goals in a grazing allotment.

Animal Unit Month (AUM) - The amount of forage required to sustain the equivalent of one cow or five sheep for one month.

Aquifer - A water-bearing bed or stratum of permeable rock, sand, or gravel capable of yielding considerable quantities of water.

Aspect - The orientation of a slope in respect to the compass; a position facing or fronting a particular direction.

Biome - An ecological formation considered in terms of both plants and animals of the area concerned and usually identified in terms of the characteristic vegetation.

Biotype - All the organisms sharing a specified similarity, such as all the species of one genus.

Browse - As a verb, to consume, or feed or eat on (a plant); as a noun, the tender shoots, twigs, and leaves of trees and shrubs often used as food by cattle, deer, elk and other animals.

Catchment - A structure built to retain water from an upstream drainage area.

Changing Season of Use - Adjusting the time of livestock grazing on a range area based on type of vegetation or stage of vegetation growth.

Chlorinated Hydrocarbon - A chemical compound containing chlorine, hydrogen and carbon. An example is DDT.

Class of Livestock - Kinds of domestic livestock grazing on a range - cattle, horses, sheep or goats, or a combination of these. May be broken down to greater detail such as cows with calves, yearlings, steers, ewes, ewes with lambs, lambs, etc.

Climax - The final vegetative community which emerges after a series of successive vegetational stages and perpetuates itself indefinitely unless disturbed by outside forces.

Cool-Season Grass - A plant which makes the major portion of its growth during late winter, early spring, and again in the fall (during the cool seasons).

Critical Wildlife Habitat - That portion of the living area of a wildlife species that is essential to the survival and perpetuation of the species either as individuals or as a population.

Decreaser - A plant species of the original vegetation that will decrease in relative abundance with continued overuse.

Deferment - Withholding of livestock grazing until a certain stage of plant growth is reached, usually maturity of seed.

Distribution - The uniformity of livestock grazing use over a range area. It is affected by water availability, topography and type and palatability of vegetative species.

Dual Use - To allow use of more than one class of livestock on the same area, at either the same time or at different times of the year.

Ecosystem - An ecological community considered together with the non-living factors of its environment as a unit.

Ecosystem Components - The animals, vegetation, soil, water, minerals, solar energy and their interactions as an ecological community.

Ecotone - A transition area between two adjacent ecological communities usually exhibiting competition between organisms common to both.

Environment - The surrounding conditions, influences or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival.

Eutrophication - The accumulation and retention of nutrients by aquatic ecosystems to the stage where vegetative decay exceeds the available oxygen supply.

Flexible Herd Composition - Usually refers to maintaining a herd of grazing animals composed of a basic breeding herd plus steers and heifers so that rapid adjustments in numbers can be made as a result of favorable market conditions, drought, or other natural factors. For example, steers and heifers can be marketed immediately as a result of deficiency of forage due to drought.

Forb - A broadleaved herb, a weed.

Frail Lands - Some areas which exhibit low productivity and stability. Surface disturbance readily accelerates erosion of these areas.

Frequency of Use - An expression of the periods of grazing use and non-use describing how often and for how long grazing occurs.

Grazing District - An administrative subdivision of the rangelands under the jurisdiction of the Bureau of Land Management, established pursuant to the Taylor Grazing Act of June 28, 1934. Section 3 lands are those national resource lands within a grazing district boundary pursuant to Section 3 of the Act.

Section 15 lands are those national resource lands outside a grazing district boundary pursuant to Section 15 of the Act.

Grazing System - A systematic sequence of grazing use and nonuse of an allotment to reach identified multiple-use goals or objectives by improving the quality and quantity of the vegetation.

Herbivore - A plant-eating animal.

Humus - Accumulated debris of plant stems, leaves and roots forming the organic material in soils.

Increaser - A plant species of the original vegetation that increases in relative abundance, at least for a time, with grazing use.

Intensity of Use - Amount of vegetation consumed by grazing herbivores, usually measured as a percentage of the annual growth.

Invader - A plant species that was absent in the undisturbed portions of the original vegetation but will become established therein under conditions of disturbance or continued overuse.

Lagomorph - An animal of the Order Lagomorpha represented by hares, rabbits and pikas. They resemble rodents and were formerly classified as such, but were separated from rodents on the basis of dental characteristics.

Lay-Down Panel - Fencing constructed so that sections can be lowered from the vertical position when not needed to prevent snow damage or permit passage of wildlife species.

Lease - An authorization permitting the use of national resource lands outside of a grazing district for the grazing of livestock during a specified period of time.

License - An authorization which permits the grazing of a specified number and class of livestock on a designated area of grazing district lands for a period of time, usually not in excess of one year.

Livestock Operation - The management of an area of land so that a significant portion of the income is derived from the continuing production of livestock.

Management Action - A supervisory decision affecting the manner and method of use of the resources of a land area.

Management Framework Plan (MFP) - Land use plan for national resource lands which provides a set of goals, objectives and constraints for a specific planning area to guide the development of detailed plans for the management of each resource.

Microclimate - The local climate of a given site or habitat of variable size.

Microfauna - The small or strictly localized animal forms of an area, usually referring to minute forms perhaps invisible to the naked eye.

Moisture Infiltration - Water penetration into the soil through pores of the soil. Rate and amount of infiltration is limited by size and abundance of pores and water absorption capability of the soil.

Multi-Discipline Team - A group of persons who collectively have expertise on all aspects or components of a project or problem to be studied and/or solved.

Multiple Use - Harmonious and coordinated management of the various surface and subsurface resources, without impairment of the land, that will best meet the present and future needs of the people.

Multiplier Effects - The amount of additional income expected to be generated in all sectors of a regional economy as a result of an increase in income of the livestock sector.

Nonwettable Soils - A condition of the soil which may occur after wildfire where the soil loses its affinity for water.

National Resource Lands (NRL) - Those Federally owned lands under jurisdiction of the Bureau of Land Management. Formerly known as the public domain.

Off-Road Vehicle (ORV) - Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland or other terrain.

Overgrazing - Consumption of vegetation beyond the endurance of a plant to survive.

Parent Material - The unconsolidated and more-or-less chemically weathered mineral or organic matter from which soil develops.

Permit - An authorization which allows the grazing of a specified number and class of livestock on a designated area of grazing district lands during specified seasons each year for a period of usually ten years.

Phenoxy Chemical - A compound containing the univalent radical $C_6 H_5(-)$, an acid common to herbicides such as 2,4-D; 2,4,5-T, and silvex. As hormonal-type herbicides, they stimulate natural plant hormones and cause uncoordinated growth, accelerated metabolism and eventual death of the plant.

Physiological Needs of Plants - Requirements of vegetation to survive, the need to manufacture food, to replenish food reserves, to produce viable seed, and to have new seedlings become established.

Plant Density - The number of individuals per unit of area. Refers to the relative closeness of individuals to one another.

Plant Growth Requirements - Similar to physiological needs of plants but more specific; pertains to requirements of soil for rooting, water, minerals, light and air.

Plant Vigor - The relative well being and health of a plant as reflected by its ability to manufacture sufficient food for growth and maintenance.

Predator - An animal that preys on one or more other animals that man wishes to preserve for his own use.

Programmatic Statement - A comprehensive and general statement resulting from an analysis of the adverse and beneficial impacts on the environment as it is being affected by an ongoing management program.

Public Land Law Review Commission (PLLRC) - The Commission established by Public Law 88-606 on September 19, 1964, to study existing laws and procedures relating to the administration of the public lands of the United States.

Public Participation - A component of the Bureau Planning System providing the opportunity for citizens as individuals or groups to review resource management proposals and offer their suggestions or criticisms of the various alternatives offered.

Range Adjudication - The allocation of grazing allotments, season of use, numbers and class of livestock to qualified livestock operators.

Range Condition and Trend - A description of the current status and estimated future improvement or deterioration of the vegetation and soil.

Range Conservationist - A person trained in the use and management of natural resources in accordance with principles that assure a sustained yield of renewable benefits and values without impairment of environmental quality.

Range Improvement - A structure, action or practice that increases forage production, improves watershed and range condition, or facilitates management of the range or the livestock grazing thereon.

Regional Economics - Of, relating to, or concerned with the production, distribution and consumption of commodities and services on a regional area basis as compared to a local or national basis.

Rest - As used in this statement, refers to deferment of grazing on a range area to allow plants to replenish their food reserves.

Root Plow - A machine designed to cut the roots of woody-plant species below the soil surface. Root plows require a tractor of high horsepower and are usually mounted on the rear of crawler-type tractors.

Rotation - A grazing system providing for sequential movement of livestock from one pasture to another on the basis of allowing for regrowth of vegetation and maintenance of vegetative vigor.

Roughness Coefficient - Terminology expressing the proportional relationship between the velocity of water flow in natural channels to the roughness of the channel as influenced by obstructions such as vegetation and boulders.

Secondary Poisoning - Physiological impairment or death caused to an animal as a result of eating an animal that has died from ingestion of poison.

Sedimentation - The action or process of deposition of material borne by water, wind or glacier.

Single Use Potential - The maximum production of a resource such as forage, without environmental or policy constraints.

Stocking Rate - The degree to which a grazing unit is stocked with livestock, usually expressed in AUMs. The stocking rate may be more or less than the carrying capacity.

Strutting Ground - A localized area used by some species of the grouse family to display their courtship rituals.

Supportive Measures - Structures, actions or practices where objectives or justifications are to increase forage production and utilization, to improve range conditions, or to facilitate management of the range or the livestock grazing thereon; range improvements.

Tree Crusher - A self-propelled machine that moves on large diameter steel rollers studded with cutting blades. It utilizes power and weight to push trees and brush down and crush or splinter them. One of the larger machines weighs 55 tons and takes a swath of 26 feet.

Ungulate - A hoofed animal.

Utilization - The proportion of current year's forage production that is consumed or destroyed by grazing animals. Usually expressed as percentage. See also Intensity of Use.

Warm Season Grass - A plant which makes most or all of its growth during the spring, summer or fall and is usually dormant in winter; grows during the warm seasons.

Appendix I-A

BOISE FRONT
ALLOTMENT MANAGEMENT PLAN
11-01-35-01

BOISE FRONT PLANNING UNIT

BOISE DISTRICT

BUREAU OF LAND MANAGEMENT

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APPENDIX . . . .

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APPROVAL

The following plan is prepared to meet criteria necessary for a coordinated Resource Management Program over 14,700 acres of land contained in the Boise Front Watershed. This plan will serve as the basis for cooperative management among the Idaho Fish and Game, Forest Service, Bureau of Land Management, Highland Livestock and Land Company, Claude Wiseman, Lee White & Son, and Larry Smith.

Approved by
Idaho Fish and Game

/s/ John R. Woodworth Date 03-20-70
Director

Approved by
Forest Service

/s/ Charles T. Coston Date 03-20-70
Acting Supervisor,
Boise National Forest

Approved by
Bureau of Land Management

/s/ Joe T. Fallini Date 04-17-70
State Director

Approved by
State Land Board

/s/ Gordon Trombley Date 03-23-70
Commissioner

OPERATION AGREEMENT

BY

Highland Livestock & Land

Lee White & Son

Larry Smith

Claude Wiseman

We the undersigned have reviewed the Boise Front Allotment Management Plan and understand its provisions. We understand that the Program outlined both during the interim period and under the Rest Rotation System will serve as a basis for our respective licensed use. We agree to operate our cattle and sheep in the manner prescribed by the designated authority except as adjusted from time to time under mutual agreement. We also understand that development and maintenance of management facilities will be subject to mutual agreement in provisions of funds, labor, material, and equipment of all parties involved. We also agree that said agreement will be binding upon assignees in the manner previously outlined.

Highland Livestock & Land Company
By /s/ Robert M. Naylor DATE 02-18-70
President

/s/ Claude Wiseman DATE 03-11-70
Rancher

/s/ Lee White & Son DATE 03-10-70
Rancher

/s/ Larry R. Smith DATE 04-09-70
Rancher

I. INTRODUCTION

This allotment Management Plan is designed to outline a Grazing Management System, which is compatible with other use demands and resource needs.

This system has been especially devised to fulfill the outlined objectives in Section II of this plan.

The following ownerships make up a total of 17,020 acres:

1.	Idaho Fish & Game Department	5,420	
2.	Fish & Game State Lease	640	
3.	Bureau of Land Management	6,160	
4.	Highland Livestock and Land	800	
5.	Claude Wiseman	360	
6.	Lee White	1,120	
7.	State of Idaho	640	
8.	Black Hornet Mine	60	
9.	U. S. Forest Service	1,820	
		17,020	
		240	Private Land
		17,260	of non-user

Background

Location

The center of the area is approximately 7 - 8 miles from Boise, Idaho, due north of Lucky Peak Reservoir, in Townships 2 & 3 North, Ranges 3 & 4 East, more commonly known as the Boise Front, see Exhibit 1.

History

Domestic livestock have grazed the area on a continuous year-long manner since the late 1800's. Studies made by the Idaho Fish & Game Department indicate that the area is one of the most critical mule deer winter ranges for the largest and most productive mule deer herd in the State. Prior to the construction of Lucky Peak Dam, it also served as a deer migration route from the Boise Ridge Area to the Snake River plains.

Social-Cultural Demands

Livestock grazing, big game and upland game bird hunting, hiking, motorbiking and horseback riding are the most important demands on the resources involved. A 50% increase during the next 20 years over the present 18,000 visitor days per annum is predicted.

Climate

The Boise Front has cold winters and dry, hot summers. Average annual temperature extremes are approximately 0° to 100° F. In winter months average daily maximum and minimum temperatures are 39° and 27° F. Average daily maximum and minimum temperatures during the summer are 84° and 55° F. The frost-free season ranges from 120 - 159 days on the Front. The upper reaches of the area receive 18 to 20 inches of precipitation annually; Boise receives about 10 to 12 inches per year. The majority of the moisture received on the Front is snow.

Topography

The majority of the slopes are moderately steep with about one-fourth of the area having slopes greater than 30%. Generally slopes face a south-southwesterly direction. Elevations range from 2800 to 5968 feet. Warm Springs Creek, Squaw Creek, Maynard Gulch, Highland Valley Creek plus two more small unnamed drainages are the major drainages.

Soils

All of the planning area is in the Chestnut Brown Litholsal great soil group. Most soils are formed from Lake sand deposits and granitic rocks. Both parent materials produce angular grained, poorly graded and erodable soils. Deep gulches have been cut where the soil has been disturbed and vegetation removed.

Wildlife

Wildlife habitat is in fair to poor condition due to fires, erosion and excessive grazing. Principle wildlife species are mule deer, chukar partridge, Hungarian partridge, valley quail, mourning dove, and cottontail rabbits. Other small mammals, songbirds, etc., are indigenous to the Front; however, all species will become more numerous with improved habitat. Large winter deer populations constitute a critical use pressure which may be alleviated through the proposed plan of management.

II. OBJECTIVES

General

1. To generate development of the multi-ownership 14,700 acre area using livestock as a tool under a systematic grazing formula.

   A. To stabilize watershed.

   B. To sustain an important deer population.

   C. To provide recreational opportunities.

   D. To produce forage for a stabilized livestock industry.

Specific

Specific objectives must be declared in projective quantitative outcomes, then measured by an evaluation procedure which is Part IV of this plan. The following specific objectives indicate what benefits will be derived by cooperating individuals or agencies:

Rancher	Idaho Fish & Game Department Bureau of Land Management Forest Service
Items generally weighed on economic values	Items weighed on Resource and Multiple Use Values
1. Grazing season longer March - October	1. Increase bitterbrush density by 15%. Increase deep-rooted perennials from 25% to 80%.
2. Reduce operating costs in handling livestock by 15%.	2. Mutually plan, design & stake fences & water developments, eliminating excessive livestock movement.
3. Improve produce for market (Increase weiner weights 5%).	3. Limit erosion; heal gullies; raise local water table.
4. Allowable AUMs increased proportionately over present license numbers.	4. Achieve proper vegetative management, which in turn will provide more feed for wildlife & domestic stock.
5. Value of ranch permit will increase.	5. Public will receive increased revenue through accelerated local economy.

6. Maintenance of range developments provided by Fish & Game & BLM as funds & labor become available.	6. Provide for a scheduled maintenance program based on prescribed need.
7. Improve perennial cover on private land from 10%-45%. Improve browse from 20%-50%.	7. Increase habitat for mule deer & other forms of wildlife. This would increase the existing effective area managed by Fish & Game 30%-40%.
8. Regulate unauthorized and damaging trails.	8. Make possible opportunity to set aside and regulate areas for hiking, horseback riding, and motorbike trails.
9. Value of base property will increase.	

III. JUSTIFICATION

The following criteria will serve to justify the development of this AMP.

Increased Efficiency of Livestock Management

Due to the homogenous land pattern created by the Idaho Fish and Game acreage contribution a practical grazing system, which will enhance the operator's margin of profit (with this added acreage under the systematic plan of management outlined in Part IV, livestock will utilize more and better feed, and will make gains throughout the season).

Wildlife

The planning area is a major portion of the Fish & Game's Unit #39 deer winter range, one of the most critical winter areas for mule deer within the state. The grazing system outlined in Part IV will:

1. Provide needed rest for grass and browse species.
2. Increase vigor of species.
3. Increase composition of desirable grasses and browse.
4. Increase volume of feed.
5. Improve an additional 9,390 acres of habitat under a management system for big game, various species of small game and upland game birds.

Economic Consideration

The following data has been compiled by the Idaho Fish & Game Department:

Mores Creek Checking Station Records For
Game Management Unit #39
Mule Deer Harvest

Year	Length	Indicated Total Kill Mule Deer	Total Checked Kill Mule Deer	Total Hunters Checked (approx. 40% of total)	Trend Counts
1959	58 days	7,421	2,480	22,057	None
1960	51 days	6,081	2,269	20,312	2,742 ground count
1961	30 days	3,458	1,555	14,551	1,338
1962	48 days	5,803	2,261	20,529	1,970
1963	37 days	5,159	2,020	20,627	1,358
1964	47 days	7,544	2,875	22,177	2,554
1965	57 days	5,876	2,394	24,978	None
1966	51 days	5,708	2,260	24,932	None
1967	50 days	6,028	2,269	23,461	None
1968	45 days	8,100	3,290	24,247	7,167 helicopter
Average	47 days	6,118	2,367	21,787	

The above figures indicate an annual deer harvest of 6,118 animals with an estimated 54,465 hunter days a year. Using a conservative average figure of $20.00 per hunter day, this amounts to $1,089,300 per annum, resulting in a tremendous impact on the local economy. The 14,700 acres involved in the system is the heart of the winter deer range for Unit #39.

Watershed

U. S. Soil Conservation Service studies estimate that silt production throughout the area averages 1.7 cubic yards per acre per year. Therefore, the 14,700 acres under this plan are producing about 25,000 cubic yards of sediment in their present state. Under proper management increased composition of perennial grasses could reduce sediment yield as much as 50% or 12,500 cubic yards.

Recreation

Approximately 175,000 people live within 50 miles of this area. The present population spends an estimated 18,000 visitor days a year on the area with 80% of the use either hiking, horseback riding, or motorbike riding. With a well-planned grazing system recreation uses and expected future uses can be incorporated into a regulated land use plan.

Cooperative Efforts

Under a system of management, cooperative planning among all interested groups, Boy Scouts, Girl Scouts and other conservation groups, will be greatly enhanced. These groups are anxious to help and, under proper supervision, could accomplish such things as browse and tree planting, construct gully plugs, trail building, and habitat development.

IV. GRAZING MANAGEMENT SYSTEM

The management system will be outlined in five parts:

1. Proposed Grazing System
2. Interim Management System
3. Sequence of Range Improvements
4. Licensing Procedure
5. Evaluation Procedure

Proposed Grazing System

After careful consideration and on-the-ground inspection with the ranchers, Idaho Fish & Game, BLM, U. S. Forest Service and Mr. Gus Hormay, an eight (8) pasture system with four high pastures ranging in elevations from 3600' to 5900', and four low pastures ranging in elevations from 2830' to 3600', system was agreed on in order to best meet our objectives set down in Part II of this plan. The following tables will describe the grazing formula and the yearly grazing schedule for the eight pasture system.

GRAZING FORMULA FOR THE HIGH PASTURE SYSTEM

	TREATMENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
A	Graze for max. livestock production.						▥	▥	▥	▥	▥	▥	▥
B	Rest for twig & seed development.	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
C	Rest for bitterbrush seed & seedling estab.	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
D	Graze for seed trampling.							▧	▧	▧	▧	▧	▧

Start of Growth

Flowering

Seed Ripe

Apply this treatment if indicated-optional treatment

YEARLY GRAZING SCHEDULE

	MANAGEMENT UNIT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
First Year 19 70	High Pasture #1						▥	▥	▥	▥	▥	▥	▥
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4							▧	▧	▧	▧	▧	▧
Second Year 19 71	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3							▧	▧	▧	▧	▧	▧
	High Pasture #4						▥	▥	▥	▥	▥	▥	▥
Third Year 19 72	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2							▧	▧	▧	▧	▧	▧
	High Pasture #3						▥	▥	▥	▥	▥	▥	▥
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fourth Year 19 73	High Pasture #1							▧	▧	▧	▧	▧	▧
	High Pasture #2						▥	▥	▥	▥	▥	▥	▥
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fifth Year 19													
Sixth Year 19													

Watershed

U. S. Soil Conservation Service studies estimate that silt production throughout the area averages 1.7 cubic yards per acre per year. Therefore, the 14,700 acres under this plan are producing about 25,000 cubic yards of sediment in their present state. Under proper management increased composition of perennial grasses could reduce sediment yield as much as 50% or 12,500 cubic yards.

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A	Graze for max. livestock production.						▥	▥	▥	▥	▥	▥	▥
B	Rest for twig & seed development.	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
C	Rest for bitterbrush seed & seedling estab.	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
D	Graze for seed trampling.							▧ Apply this treatment if indicated-optional treatment	▧	▧	▧	▧	▧
			Start of Growth			Flowering		Seed Ripe					

YEARLY GRAZING SCHEDULE

MANAGEMENT UNIT		JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
First Year 1970	High Pasture #1						▥	▥	▥	▥	▥	▥	▥
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4							▧	▧	▧	▧	▧	▧
Second Year 1971	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3							▧	▧	▧	▧	▧	▧
	High Pasture #4						▥	▥	▥	▥	▥	▥	▥
Third Year 1972	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2							▧	▧	▧	▧	▧	▧
	High Pasture #3						▥	▥	▥	▥	▥	▥	▥
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fourth Year 1973	High Pasture #1							▧	▧	▧	▧	▧	▧
	High Pasture #2						▥	▥	▥	▥	▥	▥	▥
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fifth Year 19													
Sixth Year 19													

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C	Rest for bitterbrush seed & seedling estab.	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
D	Graze for seed trampling.		Start of Growth			Flowering		Seed Ripe ▧ Apply this treatment if indicated-optional treatment	▧	▧	▧	▧	▧

YEARLY GRAZING SCHEDULE

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First Year 1970	High Pasture #1						▥	▥	▥	▥	▥	▥	▥
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4							▧	▧	▧	▧	▧	▧
Second Year 1971	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #3							▧	▧	▧	▧	▧	▧
	High Pasture #4						▥	▥	▥	▥	▥	▥	▥
Third Year 1972	High Pasture #1	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #2							▧	▧	▧	▧	▧	▧
	High Pasture #3						▥	▥	▥	▥	▥	▥	▥
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fourth Year 1973	High Pasture #1							▧	▧	▧	▧	▧	▧
	High Pasture #2						▥	▥	▥	▥	▥	▥	▥
	High Pasture #3	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	High Pasture #4	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fifth Year 19													
Sixth Year 19													

The formula will accomplish the following for perennial grasses and bitterbrush:

Perennial Grasses	Bitterbrush
1. Restore vigor	1. Produce vigor & provide more forage through maximum hedging.
2. Increase perennial composition.	2. Provide the required two years rest for maximum twig and seed production.
3. Allow for reproduction. a. Increase seed production b. Establish seedlings	3. Increase bitterbrush density through more seed production & seed planting through trampling.
4. Provide additional litter. a. Replace mineral elements b. Limit erosion	
5. Increase soil moisture and reduce soil temperature.	

The following numbers of livestock will begin the system:

1. Highland Livestock and Land - Three (3) to four (4) bands of sheep during early spring and mid-fall.
2. Lee White & Sons - 94 cattle - early spring to late fall.
3. Larry Smith - 35 cattle - early spring to late fall.
4. Claude Wiseman - 60 cattle - early spring to late fall.

Approximately 3000 - 4000 sheep during early spring and mid-fall with a total of 189 cattle from early spring to late fall will be used initially in the grazing system. If the initial number of livestock is not enough to accomplish the objectives set out in Part II, the present users will be increased up to their base property qualifications.

Cattle Grazing Procedure

Begin grazing season by turning out stock in the early*[1] spring in Low Pasture #1. Cattle will remain in this pasture until it is determined that the bitterbrush will be properly hedged or until stock shows first signs of listlessness or dropping off. Then the gates will be opened in High Pasture #1. The stock will be allowed to drift into the higher pasture at their leisure. These two treatments are both the high and low A Treatment.

The D Treatments will be applied to each system if needed. If the pasture set up for the D Treatment shows a good bitterbrush seed crop, stock will be moved into it to accomplish the desired seed planting through trampling. This A and D Treatment will be the sequence of grazing maintained through a four-year cycle. The fifth year will be the beginning of the second cycle using the same procedure. See Pages for a description of the four-year cycle in both the low and high pastures.

Sheep Grazing Procedure

During any one grazing year there will be four pastures, two in low pasture unit and two in the high pasture unit, that can receive grazing pressure. The sheep will be able to graze in either A Treatment in the spring or D or A Treatments in the fall. Their area of use will be determined each year prior to the season.

Forest Service Pasture

The Forest Service Pasture commonly referred to as the Dead Dog Allotment, approximately acres, will be used as a late summer pasture in the event a severe draught, fire and other act of God might occur in the system.

Numbers and time will be within the following limits:

1. No grazing prior to August 15th in any one year.
2. Numbers will not exceed 100 head.
3. Season will not exceed one month's use.

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*[1] Turnout date will be agreed to by users, Idaho Fish & Game & the BLM each year.

Interim Management

Interim management is that period of time before the proposed grazing system is initiated. During this period the operators will run just as they have in the past. When the needed facilities such as springs, pipelines, fences, and cattleguards have been constructed, the grazing system will begin.

The involved operators will be licensed as follows during the interim period:

1. Highland Livestock and Land

   Highland is currently licensed in the spring for three bands of sheep between 5-1/6-30 and in the fall for three bands 10-25/11-30. Numbers and time vary according to the year.

2. Larry Smith

35 cattle	4-1/6-30	31% Federal Range	33 AUMs
35 cattle	9-15/12-31	31% Federal Range	38 AUMs
			71 AUMs

3. Lee White & Son

94 cattle	4-16/9-30	51% Federal Range	194 AUMs

4. Claude Wiseman

Field #1	60	(one month use between January 1 & April 1)	11% Federal Range	6 AUMs
Field #2	57	11-1/12-31	20% Federal Range	23 AUMs
Field #3	28	3-15/5-15	100% Federal Range	56 AUMs
Field #4	23	5-15/8-30	70% Federal Range	56 AUMs
Field #3	23	10-15/12-31	100% Federal Range	199 AUMs

Proposed Development Sequence of Range Improvements

Priority	Fiscal Year	Name	Unit of Measure	Estimated Material Cost	Estimated Labor Costs	Total Costs
1	1970	Wiseman Spring	1 Each	$500.00	$500.00	$1000.00
2	1971	Broken Jug Spring	1 Each	500.00	500.00	1000.00
3	1971	Cottonwood Spring	1 Each	500.00	500.00	1000.00
4	1971	Gabiola Spring	1 Each	500.00	500.00	1000.00
5	1971	White Spring	1 Each	500.00	500.00	1000.00
6	1971	Black Hornet Spring	1 Each	500.00	500.00	1000.00
7	1971	Arrowrock Spring	1 Each	500.00	500.00	1000.00
8	1971	Unknown	1 Each	500.00	500.00	1000.00
9	1971	Unknown	1 Each	500.00	500.00	1000.00
10	1971	Unknown	1 Each	500.00	500.00	1000.00
11	1971	Unknown	1 Each	500.00	500.00	1000.00
12	1971	Highland Valley Fence	2 Mi.	2000.00	1000.00	3000.00
13	1971	Highland Valley Cattleguard	1 Each	1500.00	500.00	2000.00
				$9000.00	$7000.00	$16000.00

Alternate Plan:
Water will be hauled in areas.

Development Responsibility

Responsibility for development of proposed projects will be clearly defined prior to programming. Programming by BLM will be dependent upon available funds. Responsibility for labor, material and equipment costs will be worked out on each project approximately six months to one year before construction. Equipment for development will be furnished by BLM & Idaho Fish & Game upon request and supply. It must be remembered that the above listed projects may not be the total number needed since many springs not listed have been developed by the Fish & Game. Priorities are subject to change from time to time.

Maintenance Responsibilities

I. Maintenance Outside the Forest Boundary

The operators agree to maintain fences and springs that they have been maintaining prior to the initiation of this system, and also to perform the necessary routine maintenance on range improvements within the pasture that is currently being used by the livestock. Additional range improvements such as fences, springs, cattleguards, etc., which are new to the operator's former operations will be maintained cooperatively by the agencies involved, namely Idaho Fish & Game Department, Idaho State Land Board, and the Bureau of Land Management.

II. Maintenance Within the Forest Boundary

The operators agree to maintain that portion of the Dead Dog Allotment Fence which is on the forest, to the satisfaction of the Forest Service prior to turning livestock on the allotment.

Licensing Procedures

Bureau of Land Management

At the end of the grazing season actual figures supplied by each operator will be utilized to compute the annual grazing bill. This will enable the operator to pay for exactly what he gets from BLM land. This licensing procedure will be placed in effect after the Rest Rotation System has been adopted.

Idaho Fish and Game

The Idaho Fish and Game Department will charge for the amount of livestock use on their lands over and above the amount of livestock use rested from the lands of the private landowners.

Forest Service

A temporary association-type permit will be issued to the users prior to use on any year the Dead Dog Allotment will be grazed. Payment of grazing fees will be in advance of use and will be at the rate presently in effect on the Boise National Forest.

EVALUATION PROCEDURES

The following special studies will be completed along with other general observations to evaluate the success of the management plan.

Trend - Two to three observation points will be established on key sites. The study method will be based on manual procedures adopted to District conditions (to be further defined in a District Instruction Memo).

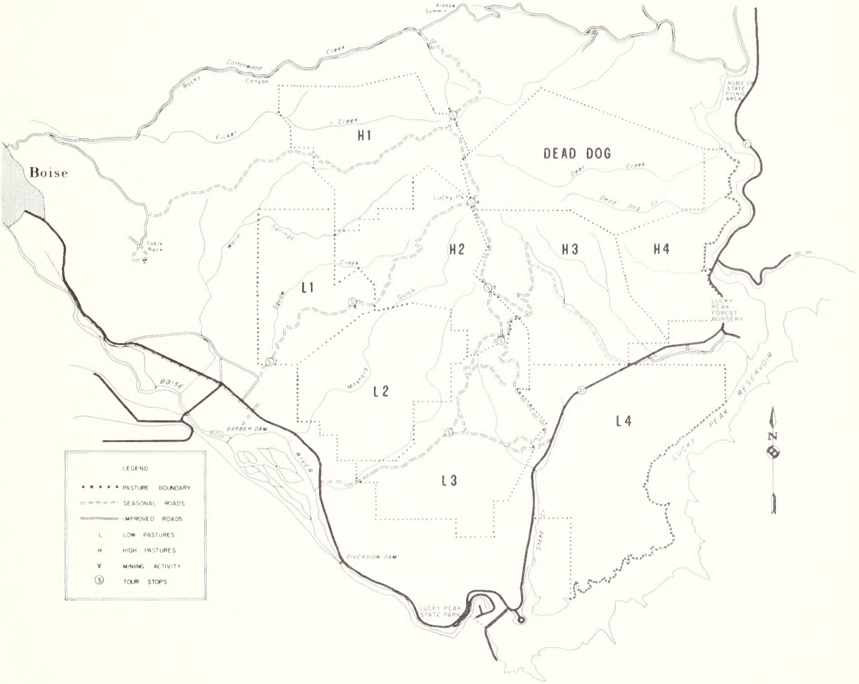
Range Readiness - Studies as outlined in District Instruction Memo 68-6 will be conducted to determine an average turnout date. Thereafter, minor adjustments will be made on an annual basis as needed.

Actual Use - Records of actual use will be maintained by each operator. BLM will have the option of making periodic checks. Form 4412-18 will be used by the operators.

Utilization - Studies will be based on the key forage plant method as outlined in the manual. Checks will be made on a triannual basis or more frequent if time and manpower is available.

Climate - Studies will be based on data obtained by the Weather Bureau Station at Boise.

LUCKY PEAK RESOURCE MANAGEMENT UNIT



Appendix II-A-1

Soil Erosion Condition Classification - By Vegetative Types

August, 1973 [1]

Vegetation Type	Condition Class Stable	Slight	Moderate	Critical	Severe	Total Acreage In Sample
Grass	19 [2]	49	25	6	1	9,095,000
Meadow	54	18	18	0	0	91,000
Perennial Forbs	11	54	9	20	6	53,000
Sagebrush	11	49	34	5	1	38,924,000
Mountain Shrub	15	49	31	5	0	1,459,000
Conifer	40	30	23	6	1	1,871,000
Waste (2% cover)	8	22	31	24	15	1,039,000
Pinon-Juniper	3	36	46	14	1	14,204,000
Broadleaf Tree	67	18	13	2	0	160,000
Creosote	2	28	54	14	2	5,496,000
Mesquite	1	18	47	33	1	803,000
Saltbrush	5	40	40	14	1	8,242,000
Greasewood	8	33	40	18	1	2,742,000
Winterfat	6	57	33	4	-	602,000
Desert Shrub	6	42	41	10	1	8,617,000
Half Shrub	4	49	44	3	0	446,000
Annuals	35	43	13	9	0	873,000
Total Acreage						94,717,000

[1] Source - Bureau of Land Management's Watershed Condition Classification Procedures.

[2] Expressed as percent of sample.

Appendix II-A-1-a

Predicted Soil Erosion Condition Classification by Vegetative Type with Proper Management and Land Treatment Completed. [1/]

Condition Classes

Veg. Type	Stable	Slight	Moderate	Critical	Severe	Acreage in Sample 1,000 ac.
Grass	45 [2/]	48	5	2	0	2,458
Meadow	93	7	0	0	0	31
Perennial Forb	No estimate					
Sagebrush	34	57 ·56	8	0.4	0.04	12,160
Mountain Shrub	20	75	5	0	0	264
Conifer	66	28	5.7	0.3	0	286
Waste (2% cover)	1	8	30	48	13	212
Pinon-Juniper	10	64	21	4	1	4,787
Broadleaf Tree	No estimate					
Creosote	1	70	28	1	0	770
Mesquite	53	23	24	0	0	262
Saltbrush	16	66	15	2.6	0.4	1,923
Greasewood	17	58	21	4	0	919
Winterfat	16	81	3	0	0	335
Desert Shrub	14	64	21	1	0	2,843
Half Shrub	26	58	16	0	0	92
Annuals	83	14	3	0	0	221

[1/] Source - Bureau of Land Management's Watershed Condition Classification Procedures.

[2/] Expressed as percent of sample.

APPENDIX II-A-2
1964 RANGE CONDITION CLASSIFICATION
NATIONAL RESOURCE LANDS - BY STATE TOTALS
BASED ON USABLE ACRES

STATE		Range Condition Classification (Usable Federal Range)				
		Excellent	Good	Fair	Poor	Bad
ARIZONA	Percent	1	9	34	45	11
CALIFORNIA	Percent	1	14	63	21	1
COLORADO	Percent	1	11	55	29	4
IDAHO	Percent	2	20	55	21	4
MONTANA 1/	Percent	1	47	46	5	1
NEVADA	Percent	2	15	56	24	3
NEW MEXICO	Percent	4	19	68	8	1
OREGON 2/	Percent	1	9	45	32	13
UTAH	Percent	-	5	51	36	8
WYOMING	Percent	2	15	51	30	2

1/ Includes North Dakota and South Dakota

2/ Includes state of Washington

Soil Stability Class

I. Soil Wetness

(a) Seeps, springs and other areas where water is on top of the soil surface.
(b) Presence of hydrophytes. The hydrophytes must be defined locally.
(c) Meadows.
(d) Black soils. These types of soils must be defined locally as having high water tables, as many black soils are well drained.
(e) Soils that are gleyed and/or mottled.
(f) Small ponds of water located adjacent to an old slump escarpment (sag ponds).

Soil wetness is very important because water tends to "float" the soil mantle just as a person "floats" in a swimming pool. The soil mantle slides out of a wet area if a road cut removes the support just as water runs out of a swimming pool if a side is removed.

II. Areas Where Consolidated Bedrock is More Than Ten Feet Below the Soil Surface

(a) Fault Zones - Consolidated bedrock is ground and fractured by the faulting action.
(b) Pockets of colluvium that have accumulated from previous erosion processes.
(c) Any type of rock that is composed of hard fragments cemented by a finer grained matrix and the matrix is weathering into clay minerals.

(Examples of this situation would be conglomerates, agglomerates, tuffs, and breccias where the matrix has undergone considerable weathering.)

(d) Areas where the rock has weathered to great depths into soft materials that can be dug with a shovel.

Consolidated, continuous bedrock close to the surface provides a sound foundation to support the soil mantle above an area of disturbance. Fractured weather or deep bedrock does not provide support once the area is disturbed. Consequently, the soil mantle slides down the hillside. Cohesionless types of soil pose the highest hazard for landsliding on areas described in this category.

III. Areas Where the Soil Mantle is Presently Sliding

(a) Tension cracks. This is where the soil mantle has cracked open as soil moves downhill away from soil that has stayed in place.

(b) Hummocky hillsides. Usually occurs in plastic soils that are slowly moving downhill.

(c) "Jackstrawed" or "crazy" trees. Trees tilted at different angles while having a straight trunk denotes very recent soil movement.

(d) Curved tree butts. The soil mantle has slid slowly during the life time of the tree.

(e) Depressions resulting from the withdrawal of material downslope.

Present sliding, as denoted by above clues, will be accelerated if the soil mantle is disturbed. Most of the time, clues listed under I and II will be found in conjunction of those listed in III.

The headwalls of drainages are usually oversteened by natural erosion processes. These areas are very prone to mass soil wasting if they are disturbed. The headwall is that portion of a stream draw which has a very sharp increase in slope gradient from the toe of the mountain to the ridge top or saddle.

Soil Classifications

Soil Classification is the systematic arrangement of soils into classes in one or more categories or levels of classification for a specific objective. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

Order is the category at the highest level of generalization in the soil classification system. The properties selected to distinguish the orders are reflections of the degree of horizon (soil layer) development and the kinds of horizons present. The 10 orders are:

Alfisols - Soils with gray to brown surface layers that contain a good supply of bases and subsoils high in clay. These soils form primarily under forest or savannah vegetation with climates of slight to pronounced seasonal moisture deficit.

Aridisols (L. Aridus, Dry) - Soils characteristic of dry places with natural horizons low in organic matter and a definite moisture deficiency. They have light colored surface soils with distinct structure. These soils have developed in arid regions under sparse shrub vegetation.

Entisols (Recent Soils) - Soils which have no distinguishable natural horizons. They may be found in practically all climate regions on recent geomorphic surfaces, either on steep slopes that are undergoing active erosion or on fans and floodplains where the recently eroded materials are deposited.

Histosols (GK. Histos, Tissue) - Soil formed from organic soil materials.

Inceptisols (L. Inceptum, Beginning) - Soils that are usually moist with natural horizons, thought to form rather quickly from altered parent materials, but not by accumulation. Generally, soil development is not evident from the soil-forming processes. These soils are found under deciduous forests in temperate humid regions and also under wet or poorly drained conditions.

Mollisols (L. Mollis, Soft) - Soils characterized by nearly black, organic-rich surface horizons with high natural fertility. These soils have an accumulation of relatively large amounts of organic matter and have good structural properties. These soils are formed in a cool subhumid to a warm, semiarid climate under varying vegetative types including deciduous forests, grasslands, halophytic plants, etc.

Oxisols (F. Oxide, Oxide) - Soils of tropical and subtropical regions characterized by extreme weathering which results in an accumulation of inactive clays, oxides or iron and aluminum and quartz. These soils are formed under humid, forested conditions.

Spodosols (GK. Spodos, Wood Ash) - Soils with subsurface horizons containing an accumulation of organic matter and compounds of aluminum and iron. These soils are formed in acid coarse-textured materials in humid and cool or temperate climates under coniferous or mixed coniferous and deciduous forests.

Utisols (L. Ultimus, Last) - Soils of humid tropical areas characterized by subsurface horizons of clay accumulation or a cemented layer (fragipan). They are low in natural fertility due to a loss of bases through weathering and removal by leaching. These soils formed under wet-dry seasons and tropical forest vegetation.

Vertisols (L. Verto, Turn) - Clayey soils with high shrink-swell potential that have wide, deep cracks when dry. These soils have developed under widely varying climatic conditions, but usually with altering wet and dry seasons.

A comparison of the new soil classification system with approximate equivalents of the old system follows:

	New (Order)	Old (Great Soil Groups)
1.	Alfisols	Gray Brown Podzolic, Gray Wooded Soil, Non-Calcic Brown soils, Degraded Chernozem, and associated Planosols and some Half-Bog soils--Zonal order
2.	Aridisols	Desert, Reddish Desert, Sierozem, Solonchak, some Brown and Reddish-Brown soils, and associated Solonetz--Zonal and Intrazonal orders
3.	Entisols	Lithosols, Regosols and Alluvial soils with some Low-Humic Gley soils--Azonal and Intrazonal orders.
4.	Histosols	Bog soils--Interzonal order
5.	Inceptisols	Ando, Sol Brun Acide, some Brown Forest, Low-Humic Gley, and Humic Gley Soils--Zonal and Intrazonal orders.
6.	Mollisols	Chestnut, Chernozem, Brunizem (Prairie, Renzina, some Brown, Brown Forest, and associated Solonetz and Humic Gley soils--Zonal and Intrazonal orders.

7. Oxisols	Laterite soils, Latosols--Zonal order
8. Spodosols	Podzols, Brown Podzolic soils, and Groundwater Podzols--Zonal and Intrazonal orders
9. Ultisols	Red Yellow Podzolic soils, Reddish-Brown Lateritic soils, and associated Planosols and Half-Bog soils--Zonal and Intrazonal orders
10. Vertisols	Grumusols (dark clay soils)--Intrazonal order

Appendix II-D

DESCRIPTION OF CHARACTERISTIC SOIL SERIES IN MAJOR BIOMES

Dominant or characteristic soils within the various biomes are described in detail in Appendices II-D-3 through II-D-11. These tables have been prepared for each biome or biological community except the subtropic community to assist those wishing to prepare more detailed analyses on specific areas. Some characteristics, uses, and limitations are given for each of the listed soil series. Specific items for each soil such as the unified classification of the subsoils for engineering uses and hydrologic groups are given as well as general information. Thus, the information may be used by engineers, hydrologists, and soil scientists as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive. They occur extensively in the region under which they are identified, but they must be viewed as examples. A detailed, on-site soil survey must be made before the total soil resource is known. More detailed information of the soils characteristics and limitations may be obtained from the soil survey reports listed in the selected references.

Definitions of Table Headings

Soil Name

Each soil series in the United States is given a name. The name identifies a specific soil just as names identify people. Soil names are correlated so that any one name applies only to a specific soil, regardless of occurrence.

Unified Classification (UC)

This is one of the two systems that classify soil material for engineering uses.

The unified soil classification system identifies soils according to their textural and plasticity qualities, and their grouping with respect to their performance as engineering construction materials. Soil materials are divided into 15 classes; eight classes are for coarse-grained material, six classes are for fine-grained material, and one class is for highly organic material. Soils that have characteristics of two classes are designated by symbols for both classes; for example, CL or ML. Each class is identified by a letter symbol. GP identifies poorly graded level and mixtures of gravel and sand with little or no fines. Soils in class SM are silty sands and mixtures of sand and silt. Soils in class ML are inorganic silts of low liquid limit that are mixed with sand and clay. Soils that are predominantly silts and clays that have a low liquid limit are in class CL. The symbol CH identifies inorganic clays that have a high liquid limit and plasticity.

The first letter of the class symbol indicates the grain size, for example, G stands for gravel, S for sand, M for silt, C for clay, and O for organic. The odifying terms indicated by second letter are P for poorly graded, W for well graded, M for silty, and C for clayey. The symbol L stands for low liquid limit and H for high liquid limit.

Available Water Capacity (AWC)

Available water capacity refers to the total quantity of water available for plant growth that is stored in the effective root zone of the upper 60 inches of the soil profile at field capacity. It is largely dependent upon the effective depth, texture, structure, porosity, organic matter content, and coarse fragment content. In general, profiles that contain 50 percent coarse fragments by volume will only have one-half the moisture holding capacity of a comparable soil that is free of coarse fragments.

Hydrologic Groups (HG)

Soils are placed in hydrologic groups according to their potential to yield run-off. This information is used in watershed planning. Various hydrologic groups range from (A), that shed almost no precipitation to (D), that shed nearly all the precipitation.

A - Very deep, coarse and moderately coarse textured soils that transmit water through their profile and substratum at a high rate. These soils have the lowest run-off potential.

B - Medium to fine-textured, moderately deep to very deep soils having a moderate rate of water transmission through the profile.

C - Fine-textured, deep and very deep soils that have a slow rate of water transmission through the subsoil.

D - Fine-textured, deep soils, and impervious material exposed or covered by a thin mantle of soil. These soils have the highest run-off potential.

Relief

Relief is expressed as a range in the slope percentage that each soil may have.

Appendix II-D-1. Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Northern Temperate Grassland

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
WILLIAMS	Montana Dawson Co.	CL	12	B	1-8	Crops	Cropland
Limitations - Slight to moderate erosion hazard.							
CHERRY	Montana Dawson Co.	CL	10-14	C	0-25	Crops Grasses	Cropland Rangeland
Limitations - Slight to moderate erosion hazard, poor road fill material.							
FARGO	Montana, Judith, Basin Area	CH	--	D	0-3	Sedges & Rushes	Pasture
Limitations - Poorly chained, calcareous clays, high water table, severe compaction hazard, slight erosion hazard, soil management is very difficult.							
SLICKSPOTS	Sedwick Co. Colorado	ML	2-4	B	0-5	Winter Grains	Dryland farming
Limitations - Pan exists of about 15 inches, severe erosion hazard.							
DUNE LAND	Morgan Co. Colorado	SP	3-6	A	5-25	Sparse Grass	Limited grazing
Limitations - Dunes are actively blowing, very severe wind erosion hazard.							

Appendix II-D- 1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
BAINVILLE	Sterrk Co. N. Dakota	CL	2	C	3-40	Crops & Grass	Cropland, rangeland
Limitations - Severe wind and water erosion hazard, over clayey shale, low natural fertility.							
CRETE #1	Nebraska	CH	9-12	-	0-5	Row crops, hay & pasture short & reed grasses	Range, farming
Limitations - Moderate erosion hazard, high in fertility, high shrink-swell potential.							
TILLMAN #2	Texas	CL, CH	9-12	-	1-3	Short grasses small grains	Range cultivated crops
Limitations - High natural fertility, droughty, slight erosion hazard.							
BADLAND #2	Texas	--	--	D	2-12 to 20-75	Some short grasses	--
Limitations - This land supports little vegetation. It is thoroughly dissected by large gullies and by bald ridges and knobs; high erosion hazard.							
PORT #3	Oklahoma	ML. CL	6-9	C	nearly level	Small grains hay, orchards, pasture	Farming
Limitations - Flood plain, calcareous substratum, thick surface layers.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
RICHFIELD #4	Kansas	CL, CH	9-12	C	3	Small grains, mature grasses	Dry farming, range

Limitations - Table land, well drained, susceptible to wind and water erosion, natural fertility is high.

#1 - USDA, SCS, Soil Survey, Gage County, Nebraska, 76 pp, Illustrated 1964.

#2 - USDA, SCS, Soil Survey, Foard County, Texas, 71 pp, Illustrated 1964.

#3 - USDA, SCS, Soil Survey, Comanche County, Oklahoma, 58 pp, Illustrated 1967.

#4 - USDA, SCS, Soil Survey, Wichita County, Kansas, 63 pp, Illustrated 1965.

Appendix II-D-1 (Continued)

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Southern Temperate Grassland

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
REEVES #2	Texas	CL	3-6	C	0-20	Desert shrub, salt tolerant grasses	Range
Limitations -	Salinity, high corrosion potential, calcareous outwash, gypsum in the subsoil.						
BREWSTER #3	Texas	GC, GM	0-3	D	6-60	Short grasses, mid grasses, desert shrub	Range wildlife, recreation
Limitations -	Bedrock within 20 inches, stony.						
GOLIAD #3	Texas	CL	3-6	C	0-12	Short and mid grasses	Range, crops, wildlife
Limitations -	High shrink-swell potential, severe building foundations problems, high corrosion potential, shallow to moderate depths over caliche.						
ECTOR #2	Texas	CL	0-3	D	0-3	Short & mid grasses	Range, crops, wildlife, recreation
Limitations -	Bedrock or cemented caliche within 20 inch depth, stoniness, moderate, shrink-swell potential, high erosion hazard.						

Department of Ag. Communications, Texas A&M University, General Soil Map of Texas.
#2 - USDA, SCS, Soil Survey, Howard County, Texas, 68 pp, Illustrated 1969.
#3 - USDA, SCS, Unpublished Soil Descriptions.

Appendix II-D-1 (Continued)

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Palouse Prairie Grassland

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
CONDON	Oregon	CL	3-6	C	0-35	bb wheat, I fescue	Range, dry farmland
Limitations - Wind erosion hazard is medium to high.							
WALLA WALLA #1	Oregon	CL	6-9	B	0-35	bb wheat, I fescue	Range, dry farmland
Limitations - Wind erosion hazard is medium to high.							
WUNTHERN #1	Oregon	SM, ML	6-9	C	35-70	Idahofescue	Range
Limitations - Somewhat excessively drained, stony or rock north facing soil erosion hazard is severe, fertility is moderate.							
LICKSKILLET #1	Oregon	CL	2-5	D	7-70	bb wheat	Range
Limitations - Very to extremely stony, south facing uplands, natural fertility is low.							
QUINCY #2	Washington	SP	0-3	A	0-30	Sagebrush, grassland	Range
Limitations - Excessively drained soils in dunes, severe wind erosion hazard.							

#1 - USDA, SCS, Soil Survey, Sherman County, Oregon, pp 104, Illustrated 1964.
#2 - USDA, SCS, Soil Survey, Benton County, Washington, pp 72, 1971.

Appendix II-D-1 (Continued)

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the California Prairie Grassland

<table>
<tr><th>Soil Name</th><th>Location</th><th>Unified Classification</th><th>Available Water Capacity (inches)</th><th>Hydrologic Group</th><th>Relief (%)</th><th>Vegetation</th><th>Major Use</th></tr>
<tr><td>MERCED</td><td>California</td><td>CH,
ML</td><td>12+</td><td>C/D</td><td>0-3</td><td>Crop plants, annual grasses</td><td>Row crops</td></tr>
<tr><td colspan="8">Limitations - Fine textured alluvium, most has been made land, alkaline and saline, pumping is done to remove water from soil.</td></tr>
<tr><td>FRESNO</td><td>California</td><td>ML,
CL</td><td>12+</td><td>C/D</td><td>0-3</td><td>Natural range</td><td>Field crops, irrigated pasture</td></tr>
<tr><td colspan="8">Limitations - Sandy alluvium, saline-alkalin, difficult to establish vegetative cover, high water table.</td></tr>
<tr><td>HANFORD</td><td>California</td><td>ML,
SM</td><td>9-12</td><td>B</td><td>0-3</td><td>Vegetable crops, etc.</td><td>Cultivated, irrigated</td></tr>
<tr><td colspan="8">Limitations - Sandy alluvium, water table 30-75 feet.</td></tr>
<tr><td>POSITAS</td><td>California</td><td>CH</td><td>1-4</td><td>D</td><td>0-30</td><td>Annual grasses and forbs</td><td>Pasture or range</td></tr>
<tr><td colspan="8">Limitations - Gravelly, cobbly alluvium, water supplies are short, high erosion hazard.</td></tr>
</table>

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
VISTA	California	SM	1-4	C	3-70	Annual grasses and forbs	Range
Limitations - Shallow to moderately deep upland soils, water supply is limited, high erosion hazard.							
CIBO	California	CH	5-8	D	3-70	Annual grasses and forbs	Range
Limitations - Clayey soils over igneous rock outcrops are common, water sources are limited.							
AUBERRY	California	SC	5-8	D	3-70	Trees, grasses, and shrubs	Range, dry farmed, grain
Limitations - Moderately coarse textured soils on upper foothills, rock outcrops are common, erosion is moderate to severe.							

USDA, SCS, Soil Survey, Eastern Fresno Area, California, pp 323, 1971.

Appendix II-D-1 (Continued)

Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the Hot Desert

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
ANTHONY #1	Arizona	SM	9-12	-	0-5	Annual grasses, shrubs and cacti	Range, irrigated crops, urban development
Limitations - Alkaline and calcareous throughout, moderately rapid permeability.							
MOHAVE #1	Arizona	CL	9-11	-	0-3	Annual grasses, desert shrubs	Desert range, irrigated crops, urban development, wildlife
Limitations - Calcareous throughout.							
CAIRE #2	Arizona	SM	0-3	-	0-30	Annual grasses, desert shrubs	Range, wildlife
Limitations - Calcareous, gravelly over a hardpan, natural fertility is low.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
CIONEHA #3	California	SM, GM	0-3	C	5-30	Annual grasses, small grains	Range, dryland farming, pasture, homesites
Limitations - Somewhat excessively drained upland soils, high erosion hazard, tapid permeability.							
CHINO #3	California	CL	9-11	B-C	0-2	Annual grasses, weeds, small grains, grasses and legumes	Hay, pasture, dryland grain, homesites
Limitations - Somewhat poorly drained to poorly drained floodplains, saline-alkali soils, slight erosion hazard, can be drained to improve salt content.							
ROCKLAND #3	California	--	0-3	D	15-75	Annual grasses,	Wildlife
Limitations - Granite boulders and rock outcrops that cover 35 to 60 percent or more of the surface, high erosion hazard.							

#1 - USDA, SCS, Soil Survey, Tucson-Avra Valley Area, Arizona, pp 70, Illustrated, 1972.
#2 - USDA, SCS, Soil Survey, Safford Area, Arizona, pp 57, Illustrated, 1970.
#3 - USDA, SCS, Soil Survey, Western Riverside Area, California, pp 159, Illustrated, 1971.

Appendix II-D-1 (Continued)

Characteristics, Uses and Limitations of Dominant Soils Occurring in the Cold Desert

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
BILLINGS	Utah	ML	6-10	C	0-10	Range, irrigated crops and grasses	Range, cropland
KENILWORTH	Utah	SM	3-5	B	0-20	Juniper-pinon	Range
Limitations -	Shallow, droughty, calcareous, reseeding hazard, moderate erosion hazard, stony soil.						
JEKLEY	New Mexico	CL	2-6	C	3-40	Pine-grass	Forest, range
Limitations -	Moderate to severe erosion hazard, shallow soil, cold soil temperatures, high fertility.						
HUMBOLT #1	Nevada	MH	9-12	D	0-3	Salt tolerant shrubs and grasses, irrigated crops	Irrigated crops
Limitations -	Imperfectly drained along streams and shallow lakes, saline and alkali, slight erosion hazard.						

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
QUINCY #1	Nevada	SP	0-3	A	3-12	Greasewood, rabbit brush, Indian grass	Range, some vegetation
Limitations -	Excessively drained, wind blows verticals, rapid infiltration, natural fertility very low, severe erosion hazard, wind and water.						
PLACERITOS #1	Nevada	ML	9-12	C	0-3	Greasewood, saltbrush	Range, irrigated crops
Limitations -	Imperfectly drained in alluvium, saline-alkali sacts, water table four to six feet, slight erosion hazard.						
VOLTAIRE #2	Nevada	CH, MH	9-12	D	0-3	Saltgrass, sedges, fescue	Pasture, hay, and grains
Limitations -	Poorly drained in clay alluvium, fluctuating water table 20 to 36 inches, natural fertility is high.						
MOTTSVILLE	Nevada	SW, SM	3-6	A	3-45	Big sage, bitterbrush	Grazing
Limitations -	Excessively drained, alluvial faces, erosion hazard slight to moderate, susceptible to wind erosion, natural fertility is low.						

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capaicty (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
BAKEOVEN #3	Idaho	ML, CL	0-3	D	0-80	Big sage, sandberg bluegrass	Grazing
Limitations - Very shallow sacts on basalt, erosion hazard severe on steeper slopes, very strong throughout.							
GEM #3	Idaho	CH, MH	6-9	C	0-60	Big sage, bb wheat	Dryfarmed, irrigated, range
Limitations - $CaCo_3$ below 15 feet, slight to severe erosion hazard.							
DESCHUTES #4	Oregon	SM	3-6	C	0-20	Juniper, grassland	Range, irrigation, homesites
Limitations - Somewhat excessively drained, high terraces, wind erosion is high, natural fertility is low.							
DAY #4	Oregon	CH	3-6	D	6-40	Big sage, bb wheat	Range
Limitations - High shrink-swell, cracks when dry, high water erosion hazard.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
SALISBURY #4	Oregon	CL	3-6	D	0-20	Big sage, Idaho fescue, bb wheat	Range dry farmed, small grains

Limitations - Well drained soils with silic-cemented pan, stony soils.

#1 - USDA, SCS, Soil Survey, Lovelock Area, Nevada, pp 87, Illustrated, 1965.

#2 - USDA, SCS, Soil Survey, Carson Valley Area, Nevada, pp 129, Illustrated, 1971.

#3 - USDA, SCS, Soil Survey, Gem County, Idaho, pp 188, Illustrated, 1965.

#4 - USDA, SCS, Soil Survey, Prineville Area, Oregon, pp 89, Illustrated, 1966.

Appendix II-D-1 (Continued)

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Woodland-Bushland Biome

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
ARNOLD #1	California	SP, SM	3-5	A	9-50	Annual grasses and shrubs	Range
Limitations -	Somewhat excessively drained sandy soils over soft sandstone, erosion hazard is moderate to severe, low fertility.						
CAMARILLO #1	California	SM	7-9	C	0-2	Salt tolerant grasses and shrubs	Vegetables, lemons, & homesites
Limitations -	Poorly drained sandy soils, where not drained water table is at two feet, subject to flooding, high fertility.						
DIABLO #1	California	CL	6-9	D	9-50	Annual grasses and oak	Range
Limitations -	Well drained clays in shale uplands, erosion hazard moderate to severe, high shrink-swell potential.						
GAVIOTA #1	California	SM	0.5-1	D	15-50	Annual grasses, brush and oaks	Range
Limitations -	Shallow well drained sandy soils over sandstone, erosion hazard is moderate to severe. Inherent fertility is low.						

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
GAZOS #1	California	GM	3-6	C	15-75	Brush and annual grasses	Range and homesites
Limitations - Silty soils over fractured shale, erosion hazard is severe, natural fertility is high.							
LOS OSOS #1	California	CL	4-8	C	9-50	Annual grasses, forbs, birch, oak	Range, citrus field crops, homesites
Limitations - Clayey soils over shale, erosion hazard is severe, natural fertility is high.							
MOCHO #1	California	ML, CL	8-10	B/C	0-9	Annual grasses, forbs	Row crops, orchards, field crops, homesites
Limitations - Well drained loams on fans, no erosion hazard, fertility is medium.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
SALINAS #1	California	CL, ML	10-11	C	0-9	Annual grasses, forbs	Row crops, field crops, orchards, range, homesites
Limitations - Clayey soils on plains, no erosion hazard, high in fertility.							
SANTA LUCIA #1	California	GC	3-5	C	15-75	Annual grasses, and brush	Orchards, range, homesites
Limitations - Shaley uplands, erosion hazard is moderate to severe. Inherent fertility is moderate.							
TULLHOWSE #2	California	SM	1-2	D	5-65	Scrub oak, brush and annual grasses	Range recreation
Limitations - Excessively drained shallow sandy soils from granite, erosion hazard moderate to high, fertility is low.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
LAS POSAS #2	California	CH	4-6	C	2-65	Chaparral-oak, annual grasses	Field crops, row crops, orchards, range
Limitations - Sandy soils from basic igneous rocks, fertility is medium, erosion hazard is high to very high.							
BOOMER #2	California	CL	7-10	B	15-75	Conifer forest, deciduous	Wood products
Limitations - Loams over metamophosed uplands, erosion hazard is very high, fertility is moderate.							

#1 - USDA, SCS. Soil Survey, Ventura Area, California, pp 148, Illustrated, 1970.

#2 - USDA, SCS, Soil Survey, San Diego Area, California, Draft Manuscript, Portland, Oregon.

Appendix II-D-1 (Continued)

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Montane Coniferous Forest

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
JUGHANDLE #1	Idaho	GM	6-9	B	12-65	Conifer forest, forage	Wood products, summer range
Limitations - Somewhat excessively drained, erosion hazard is severe to very severe, fertility is moderate to low.							
KLICKER #1	Idaho	GC	6-9	C	12-65	Conifer forest, forage	Wood products, summer range
Limitations - Erosion hazard severe to very severe, moderate fertility.							
MARIPOSA #2	California	ML, CL	0-3	C	9-85	Conifer forest	Wood products, range
Limitations - Shallow, rocky uplands, erosion hazard is very severe.							
JOSEPHINE #2	California	ML	6-9	B	3-71	Conifer forest, hardwood, brush	Wood products, range
Limitations - Gravelly or rocky soils, fertility is moderate, erosion hazard is moderate to severe.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
AUBURN #2	California	ML, CL	3-6	C	3-71	Grass, oak, brush	Range, dry farmed, hay and grain
Limitations - Shallow foothills, moderate fertility, erosion hazard is moderate to very severe.							
WOODSIDE #3	Montana	SM, ML	3-6	A	5-35	Conifer forest	Wood products
Limitations - Somewhat excessively drained footslopes and terminal moraines, low natural fertility, erosion hazard is high.							
SLOCUM #3	Montana	ML	9-12	B	0-3	Deciduous forest and grasses	Pasture, hay, small grains
Limitations - Imperfectly to moderately well drained fans and terraces, most areas are sub-irrigated. Imperfectly drained areas are saline.							
STEEUM #4	Colorado	ML	0-3	D	0-70	Pinon-juniper, grasses	Range, watershed
Limitations - Erosion hazard is very high, rock outcrops are common, 20 to 40 percent gravel content, moderately low fertility, droughty soils.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
BROLLIAS #5	Arizona	CH	6-9	-	0-30	Pine-grass	Wood products, summer range
Limitations -	Hilly uplands, 20 to 60 percent surface stones and cobbles, erosion hazard low.						
SPUNGELVILLA #5	Arizona	CH	6-9	D	0-20	Pine-juniper	Range
Limitations -	High shrink-swell potential, cracks when dry, 30 to 50 percent surface stones, erosion hazard is moderate.						
ROCKSLIDES #6	Colorado	GP	--	A	10-100	Spruce, alpine fields, mostly barren	Recreation
Limitations -	Accumulations of loam rocks from landslides, some slides are stable, some slides near faces of cliffs are unstable, no erosion hazard, springs are common at the toe slope.						

#1 - USDA, SCS, Soil Survey, Kooskia Area, Idaho, pp 96, Illustrated, 1971.
#2 - USDA, SCS, Soil Survey, Amador Area, California, pp 160, Illustrated, 1965.
#3 - USDA, SCS, Soil Survey, Bitterroot Valley Area, Montana, pp 128, Illustrated, 1959.
#4 - USDA, SCS, Soil Survey, Trout Creek Watershed, Colorado, pp 48, Illustrated, 1961.
#5 - USDA, SCS, Soil Survey, Beaver Creek Area, Arizona, pp 75, Illustrated, 1967.
#6 - USDA, SCS, Soil Survey, Fraser Alpine Area, Colorado, pp 47, Illustrated, 1962.

Appendix II-D-1 (Continued)

Some Charactertistics, Uses and Limitations of Dominant Soils Occurring in the Northwest Coastal Coniferous Forest

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
HUGO #1	California	SC	4-8	B	6-60	Conifer forests, shrubs, grasses, and forbs	Forestry
Limitations -	Very gravelly soils, very high erosion hazard.						
CLEAR LAKE #1	California	CH	8-10	D	0-3	Grasses, shrubs, and forbs	Hay, grain, orchards
Limitations -	Shrink-swell potential is high, three to five feet to seasonal water table, surface cracks when dry, runoff is slow until surface is sealed then it is rapid, drainage improves productivity.						
YOLO #1	California	ML, CL	9-12	B	0-3	Annual and perennial crops	Cultivated crops & orchards
Limitations -	Subject to flooding, well drained.						
ORFORD #2	Oregon	MH	9-12	C	3-60	Conifer forest	Woodcrops
Limitations -	Severe erosion hazard.						
ACTIVE DUNELAND #2	Oregon	SP, SM	--	-	3-40	None	Recreation
Limitations -	Unstable and subject to severe soil blowing, droughty, vegetation is difficult to establish.						

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
HEMBRE #3	Oregon	ML	9-12	B	12-60	Conifer forest	Wood products
Limitations - High erosion hazard in cut banks, highly productive, stable mantles.							
NEHALEM #3	Oregon	ML, CL	12	B	3-12	Grass & legumes	Pasture
Limitations - Alluvial bottoms, subject to flooding.							
AMITY #4	Oregon	ML, CL	9-12	C	0-3	Annual and perennial grasses	Pasture, grains, & seeds
Limitations - Somewhat poorly drained terraces, compaction potential is high, water table.							
KINNEY #4	Oregon	ML	5-9	B	3-60	Conifer forest	Wood products
Limitations - Well drained uplands, unstable on steep slopes, erosion hazard high on steep slopes, subject to frost heaving.							
CINEBAR #5	Washington	ML	12+	B	3-60	Conifer forests, annual and perennial grasses & legumes	Hay, pasture, & wood products
Limitations - Well drained, terrace, erosion hazard on sutslopes and compacted areas are high.							

Appendix II-D-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
PUYALLUP #5	Washington	SM	6-9	B	0-3	Row crops, hay, pasture, and orchards	Farming
GROVE #6	Washington	GP, GM	3-6	A	3-60	Conifer forest	Wood products, feed crops, homesites

Limitations - Glacial outwash plains, gravelly soils, soils are droughty and low in fertility.

#1 - USDA, FS & SCS, Soil Survey, Sonoma County, California, pp 188, Illustrated, 1972.

#2 - USDA, SCS, Soil Survey, Curry Area, Oregon, pp 69, Illustrated, 1970.

#3 - USDA, SCS, Soil Survey, Tillimook Area, Oregon, pp 75, Illustrated, 1969.

#4 - USDA, SCS. Soil Survey, Marion County, Oregon, pp 132, Illustrated, 1972.

#5 - USDA, SCS, Soil Survey, Clark County, Washington, pp 113, Illustrated, 1972.

#6 - USDA, SCS, Soil Survey, Mason County, Washington, pp 76, Illustrated, 1960.

Appendix II-E

RURAL DEPENDENCY ON FORAGE SUPPLIED FROM NRL

Measures of income and related population change at regional and biome levels indicate economic impact, but do not express fully the dependency of rural areas on livestock related agriculture and the role of NRL forage production. This is because heavily populated counties tend to dominate the income statistics of the regions of which they are a part. On the other hand, a selection of individual counties could be misleading and an analysis of income flows for all counties is beyond the scope of this statement. However, some additional perspective can be gained by classifying counties according to certain characteristics.

Three separate indicators are used and the 413 western counties are classified under each. The three indicators are:

1. the dollar value relationship of beef cattle sales to total agricultural sales in each county;
2. an inventory number of beef cattle in each county; and
3. the relationship of forage produced on NRL to total forage consumed in each county.

Table II-E-1 summarizes county classification by indicator. Beef cattle sales dominate the agricultural sector in approximately 47 percent of the counties. NRL makes some contribution to livestock feed in 57 percent of the counties, although the degree of the contribution is open to interpretation.

Another way of looking at the same information is to array the 413 counties, from highest to lowest, under each indicator and partition the arrays into quartiles (fourths), thereby looking at the indicator characteristic for the top 25 percent, upper half, etc. For example, arraying the counties according to the importance of beef cattle sales to total agricultural sales shows that among the upper 25 percent (104 counties) the percent of cattle sales ranges from a high of 98 percent to 68 percent; half of the western counties have beef cattle sales accounting for at least 45 percent of total agricultural sales. Looking at the contribution of NRL forage to total forage consumed, the array falls off much more rapidly with the greatest impact clearly being in the first quartile. Table II-E-2 summarizes all quartiles for each indicator.

Choosing a somewhat arbitrary cut off of 10 percent NRL forage contribution as being significant, Figure II-E-1 delineates areas where the livestock industry is relatively dependent on NRL as a significant source of raw material input. The broad lines enclose areas where NRL provide 10 percent or more of the feed consumed by beef cattle and sheep. The reader will quickly see the close correlation between the areas of Figure II-E-1 and the biomes described in Section II. The principal contribution of NRL to rural area economies via the livestock industry is in the cold desert biome, the Southern Grasslands, portions of the Northern Grasslands and transition zones from desert to mountain in Idaho and New Mexico.

Table II-E-1. Indicators of Importance of Livestock and NRL Forage Supplies to Local (County) areas, 1970.

Counties Where Beef Cattle Sales To Total Agricultural Sales Are:

	75-100%	50-74%	25-49%	0-25%
No. Counties	67	126	108	112

Counties Where Number of Beef Cattle Are:

	100,000 or more	50,000 - 99,999	25,000 -- 49,999	10,000 --- 24,999	Less Than 10,000
No. Counties	32	90	127	89	75

Counties Where NRL AUMs to Total Cattle and Sheep AUMs Are:

	50-100%	20-49%	10-19%	1-9%	Less than 1%
No. Counties	4	41	31	159	178

Table II-E-2. Results of Arraying Counties by Each Importance Indicator With Indicator Measures by Quartile, 1970.

Indicator	Range of Indicator by Quartile			
	I	II	III	IV
Beef Cattle Sales as Percent of Total Agr. Sales:	98-68%	67-45%	44-23%	22-0%
Number of Beef Cattle:	507,400-55,700	55,600-25,600	25,500-14,200	14,000-0
NRL AUMs as Percent of Total AUMs Consumed:	83-6%	6-1%	1-0%	0%

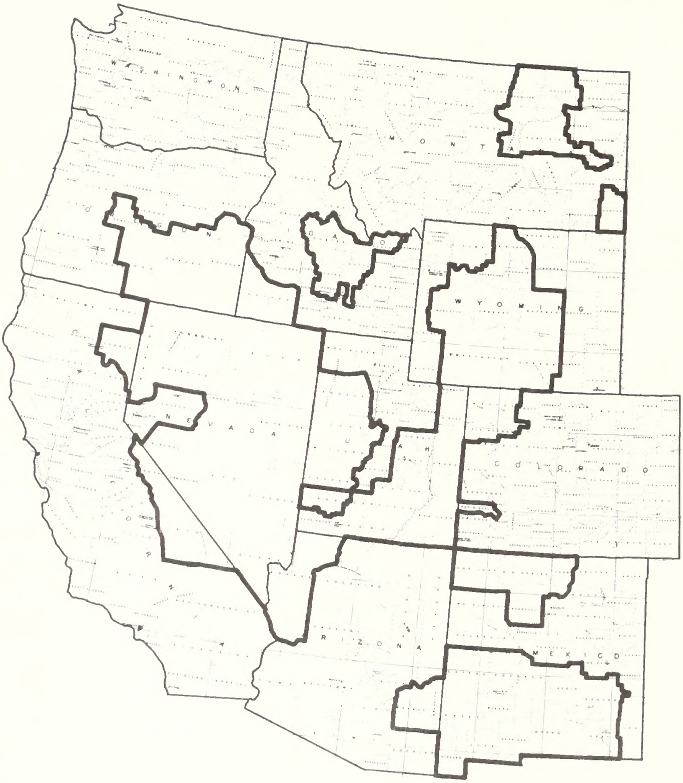


FIGURE II-E-1 AREAS WHERE TEN PERCENT OR MORE OF LIVESTOCK FORAGE IS SUPPLIED BY THE NRL. 1970.

Appendix II-F

URBAN TRENDS IN THE WEST

Throughout the West, as in most areas of the country, there has been a marked trend from 1960 to 1970 toward urbanization characterized by three processes. First, urban areas have essentially retained their own population growth; second, immigration to western areas from other parts of the country has been generally to urban areas; and third, rural populations of the West have declined by either becoming urban or by persons moving to urban areas. Table II-F-1 summarizes the urban-rural characteristics of regions within biomes. Of the 22 regions named, only four have a rural majority. Only one biome type, the coniferous forest, can be identified as having conditions which sustain rural population growth. The overall population growth rate for the 11 western states was 24 percent from 1960 to 1970; as can be seen from Table II-F-1, most of this growth occurred in urban areas.

TABLE II-F-1. 1970 Population and Urban-Rural Growth Trends by Biome and Livestock Region

Biome and Livestock Region	1970 Population	% Urban	% Change 1960-1970	
			Urban	Rural
Grassland Biome:				
N.W. Prairie	963,916	61	7	0
Calif. Cent. Valley	2,597,403	75	37	-15
Spring Wheat (NE Mont.)	74,840	29	-23	-18
Mont. Great Plain	182,653	59	8	-10
Wyo. Great Plain	181,095	64	4	- 8
Colo. Great Plain	1,455,175	86	26	-12
N.M. Great Plain	186,088	63	15	-13
So. Grassland	362,218	71	12	-21
Desert Biome: [a]				
Snake River	470,485	59	22	- 8
Cold Des. (G. Bsn.)	1,045,270	76	31	- 2
Cold Des. (Cent.)	677,039	63	13	13
Cold. Des. (Wyo.)	147,708	60	11	-13
Hot Desert	2,995,880	86	60	-10
Woodland-Bushland (Part):				
Calif. Cent. Coast	5,145,524	93	34	-21
Calif. So. Coast	10,451,069	98	31	-26
Coniferous Forest:				
N.W. Forest	4,595,838	72	32	3
Sierra Range	293,271	34	49	26
Ariz-N.M. Mtns.	95,198	42	17	13
Colo.-N.M. Mtns.	788,245	60	64	15
Utah Mtns.	359,808	75	22	3
Mont.-Wyo. Mtns.	446,990	54	13	5
Id.-Ore. Mtns.	221,652	34	14	- 3
TOTAL	33,737,365	83	32	- 5

[a] Includes approximately 30 million acres of woodland-bushland.

Social Aspect of Livestock Grazing on NRL

Throughout the West a rural-ranching ethic has persisted over time as a factor in social and community relationships. This dimension of livestock grazing management is principally individual related. Table II-G-1 shows the distribution of individual permittees by size of permit. This data suggests that in terms of people, the social aspects of grazing management on NRL may play a noticeable role in community relationships and stabilization of non economic values.

Table II-G-1: Number of Permittees and AUMs by Size of Permit for Section 3 Lands, 1967

Permit Size AUMs	Permittees 1/ No.	%	Total AUMs 2/ No.	%	Avg. No. AUMs Per Operator 3/
0-99	3,850	26.7	46,509	0.4	12
100-499	5,342	37.0	802,277	6.9	150
500-999	2,013	14.0	848,786	7.3	422
1,000-1,999	1,586	11.0	1,430,145	12.3	902
2,000-2,999	645	4.5	1,325,500	11.4	2,055
3,000-3,999	316	2.2	1,220,856	10.5	3,863
4,000-4,999	199	1.4	755,768	6.5	3.797
5,000-14,999	398	2.8	3,069,580	26.4	7,713
15,000-24,999	48	0.3	1,372,000	11.8	28,583
25,000+	23	0.2	744,140	6.4	23,354
TOTALS	14,420	100.0*	11,615,561	100.0*	xxxxxx
AVERAGE	xxxxx		xxxxx		806

*May not total due to rounding.

1/ 1967 Grazing Year, does not include free use, exchange of use and crossing permits.

2/ Computed on basis of all animals over six months of age equal 1.0 animal unit equivalent.

3/ Average number of AUMs grazed in 1966 does not always agree with permit size shown in Column 1.

Source: 1966 Cooperative Grazing Fee Survey, Statistical Reporting Service with USFS and BLM.

ECONOMIC BACKGROUND AND ANALYSIS

Assumptions and Background

In order to assess the economic impact of the proposed action and major alternatives, it will be necessary to assume alternative levels of AUM production for NRL.

1. Proposed Action: Thirty-five percent overall increase allocated to each biome on the basis of NRL present production levels and average stocking rates. The 35 percent represents a possible 1990 demand increase.
2. Alternative A: Five percent decline over a 20-year period affecting all regions.
3. Alternative B: Zero AUM production from NRL.
4. Alternative C: Seventy-three percent increase in accordance with estimates made by the PLLRC.

In assessing the economic impacts of the proposed action and major alternatives, the basic approach was to select a method of analysis which was as similar as possible to the methods used in assessing impacts upon the physical environment. Therefore, no attempt has been made to prove value or determine the feasibility of an alternative, rather the estimated impacts on income flows was selected as a means of displaying impacts on a major portion of the human environment.

In general, such impacts appear small in large areas and may become progressively more significant as the geographic areas or economic unit is reduced in size. For example, earnings from the livestock industry in 1970 accounted for about one percent of the total personal income of the 11 Western States and the contribution of NRL to livestock industry earnings is estimated at only slightly more than one percent. On the other hand, in eastern Montana, nearly 10 percent of personal income is earned in the livestock industry and about seven percent of the industry earnings is attributable to the NRL. Of course, on an individual basis, the dependency on NRL ranges from zero to nearly 100 percent.

All aspects of economic importance are not always measured by single indicators such as income. For example, some operators may be completely dependent on NRL for livestock feed during a short period of the year, for which it may be economically ruinous to substitute alternative feed sources such as hay. In certain regions, notably the hot desert areas of California and Arizona, the livestock industry is heavily influenced by feedlot operations which are not directly dependent at all on NRL, yet no cattle are bred and raised in such operations and therefore the importance of grazing to the industry is not completely reflected in percentage ratios of income.

Notwithstanding the above considerations, income flow estimates are sufficiently indicative of impacts at the biome level to be compatible with indications of physical and biological impacts identified for the same areas. The reader is cautioned not to compare annual income effects to program cost estimates in the sense of a benefit-cost ratio. For example, the total annual income effect of the proposed action is estimated at around $20 million; this flow of income, in 1970 dollars, would come into being when the management program was fully implemented and would continue as long as the program remained operative. This income flow measures the impact on regional economies within the environment being analyzed. Costs, on the other hand, are of two types: (a) development expenses which occur for only a few years, and (b) supervisory management costs extending over the life of the program. Since these costs are not assessed against the resulting income, their impacts on the environment in question cannot be established. Comparison of returns and expenses is a test of economic feasibility and not of impact. All such considerations of feasibility are more properly addressed to specific projects and procedures outside of environmental impact statements.

Tables III-A-1 and 2 summarize basic economic relationships and estimated impacts of the proposal action and major alternatives.

Table III-A-1: Livestock Earnings, National Resource Lands and Livestock Feed by Biome; 1970

	Grassland Biome	Desert Biome [1/]	Woodland-Bushland Biome [2/]	Coniferous Forest Biome
Earnings from livestock Indus. ($1,000)	500,000	360,000	80,000	180,000
Livestock Earnings as % of Personal Income	2.9	2.3	0.1	0.8
NRL Acres	18,080,000	132,720,000	700,000	20,070,000
as % of Total Area	8.0	42.9	3.6	10.2
Beef Cattle AUMs from NRL	2,890,000	5,990,000	20,000	1,110,000
as % of Total Feed	2.9	9.5	0.2	2.3
Sheep AUMs from NRL	500,000	1,970,000	4,000	250,000
as % of Total Feed	5.7	23.2	0.5	4.0

[1/] Includes approximately 30 million acres of woodland-bushland biome.
[2/] Includes only the California coastal region south of San Francisco.

Table III-A-2: Summary of Estimated Income Effects of Proposed Action and Major Alternatives By Biome and Total

	Grassland Biome	Desert Biome [1]	Woodland-Bushland Biome [2]	Coniferous Forest Biome	Total 11 Western States [3]
Total Personal Income ($1,000)	17,512,000	15,599,000	59,517,000	21,801,000	114,429,000
Livestock Ind. Earnings ($1,000)	501,000	355,000	80,000	184,000	1,120,000
Est. Ann. Earnings Eff. of Proposed Action ($1,000)	7,600	4,150	[4]	1,110	13,000
Est. Total Ann. Income Eff. of Proposed Action ($1,000) [5]	11,600	6,700	[4]	1,800	20,000
Est. Total Ann. Income Eff. of Alternative A ($1,000) [5]	-900	-1,700	[4]	-300	-3,000
Est. Total Ann. Income Eff. of Alternative C ($1,000) [5]	-20,400	-44,300	-200	-7,200	-72,000
Est. Total Ann. Income Eff. of Alternative D ($1,000)	44,600	58,400	600	11,000	115,000

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[1] Includes approximately 30 million acres of woodland-bushland biome.
[2] Includes only California coastal portion.
[3] May not add due to rounding.
[4] Too small to estimate.
[5] Includes multiplier effect in regional economies.

Demand Analysis

It is assumed that the proposed action would be phased to meet the needs of resource stabilization, demand for forage products, and other multiple uses. With respect to demand for forage products from grazing lands, the following has been abstracted from Forest Resource Report No. 19, USDA: 1/

The state of the Nation's economy will influence the management and use of the range environment. The economic situation on which projected needs and opportunities for management of the range environment are based, is briefly outlined here.

The projected population of 281 million people in the year 2000 is about 1.3 times the 1970 population. The general economy is assumed to remain stable and productive. Production value per man-hour in the year 2000 will be nearly two and one-half times what it was in 1970. The economy is expected to yield a Gross National Product (GNP) of $1,152 billion in 1980 and of $2,350 billion in 2000. The GNP will more than double in the 20 years between 1960 and 1980, and will increase by more than five times between 1980 and 2000....

Foreign trade in livestock products is a potentially important variable, and revisions of import and export policies could lead to increases or decreases in total domestic production. Nonetheless, it has been assumed that foreign policy will not undergo a major change....

Grazing of livestock (expressed here in animal unit months) is an intermediate output from range. Range livestock production, operating within the context of total production of livestock, will share the fate of the rest of agriculture. Consideration, therefore, is given to the outlook for livestock production and its implications for grazing.

Projected growth in population and income will continue to expand markets for farm products. Rising incomes will permit shifts in the composition of human diets. More foods of higher value, such as meat, will be consumed. Despite alternative sources of protein for human diets, livestock products will continue to be important to both the farmer and the consumer during the nest two decades.

Consumption of lamb and mutton, pork, eggs, and dairy products has declined recently, but consumption of poultry and beef has increased substantially. Preference for beef is expected to continue to increase.

1/ USDA, The Nation's Range Resources, Forest Resource Report No. 19-1972.

The annual per capita consumption of pounds of selected meat by civilians for specified periods and expected in 1980 and 2000 is as follows:

	Actually Consumed			Projected	
	1947-49	1957-59	1963-65	1980	2000
Beef and veal	75.3	89.2	102.9	130.0	135.0
Lamb and mutton	4.8	4.4	4.2	2.8	2.5

Veal declined from about five percent of total beef consumption in 1965 to about three percent in 1968, and it is expected to decline to about two percent by 1980 and to about one percent by the year 2000.

Per capita consumption of wool is expected to decline slightly, but total consumption will increase because of population growth, as shown in the following tabulation:

	1965	1980	2000
Wool consumption per capita, pounds	2.0	1.9	1.8
Total consumption of wool, million lbs.	387	447	554

The United States has substantial net imports of lamb and mutton, wool, and sheepskins. About 70 to 75 percent of our wool is imported, and we get up to 20 percent of our lamb and mutton from other countries. Thus, continuing preference for beef over lamb and mutton, and the impacts of imports, indicate further reduction of the domestic production of sheep.

Much of the increased demand for beef has been met by extending and intensifying operations in feedlots. In the 1950s, large numbers of cattle and some lambs went directly to slaughter from range or pastures. Now, fewer cattle are slaughtered as "grassfat," and an increasing share of meat production is from concentrates in feedlots.

The trend toward fattening beef in feedlots, coupled with a decline in dairy herds, has resulted in a relatively short domestic supply of lean beef. Imports have made up the difference. Imports of beef appriximated nine percent of domestic production in 1968. On the other hand, exports commonly are less than one percent of domestic production.

American agriculture has the capacity to respond to the projected increased demands for meat and will respond if price relationships are favorable. This capacity to respond has been demonstrated. Between 1960 and 1968 beef production increased 41 percent. This increase, along with a doubling of beef imports, provided beef for an 11 percent increase in population and for the increasing preference by consumers for beef over other meats....

In the face of the changing technology of beef production and apparent untapped productivity of pasture forage and other feed production sources, it might appear that range may not be "needed" for livestock production. No doubt it is possible that other feeds and feed sources have the potential to provide the feed now supplied by grazing the range....

There are other indicators that suggest continued high demand over the next 10 to 20 years for use of the nation's range resources for forest-range livestock grazing. Historically, cattle and sheep have been the principal marketable outputs of range ecosystems. The most consistent feature of the historic role of the range has been its use as a low-cost feed source. Furthermore, many rural economies are substantially dependent on production of livestock from range ecosystems. Increasing the production of range livestock may help strengthen these local or regional economies.

Range lands can compete as they do now in providing the additional feeder cattle needed in the next 10 to 20 years if range costs do not increase relative to other feed sources. Competition among regions of the nation will partly reflect availability of land and relative costs for raising feeder cattle. Range will continue to support domestic production of lambs and wool....

The results obtained in estimating the demand for forest-range grazing, when compared to other similar studies, appear reasonable. In summary, the projections were derived in the following manner:

> Projected population times projected per capita consumption of meat, plus other uses, results in total domestic consumption of beef and mutton. Per capita consumption was derived within a context of total food consumption including other meats, and as modified by changes in income and taste preferences.
>
> Total domestic consumption of beef and mutton was further modified by the consideration of beef and mutton imports and exports. Thus, a total domestic production of beef and mutton was estimated.
>
> Domestic production times the quantity of feed required per pound of meat produced indicated the total feed requirements and the particular mix of feeds included in these requirements. The total feed and feed mix was then modified by expected changes in the structure of beef industry, feed conversion efficiency, livestock breeding, production in feed lots, quality of feeds, knowledge of livestock diet needs, and production capabilities of various feeds.
>
> The computed result is an indication of the total grazing requirement. The total grazing requirement was then divided between grazing of improved pastures and grazing of the forest-range environment.

These grazing requirements of the forest-range environment were used to compute an index. The index was applied to the production of animal unit months in 1970...., in order to project production requirements for grazing in 1980 and 2000 from forest-range.

In addition, a long-range target was estimated for the year 2020. The resulting levels for grazing from the forest-range environment were:

	1970	1980	2000	2020
Index	100	120	150	185
AUMs, millions	213	256	320	394

The above AUM demand projection is for the total grazing industry, regardless of land ownership. Therefore, for the present study, a linear interpolation of the index to 1990 (35% increase) was applied to the present level of AUMs from NRL and the resulting impact on income flows estimated on a 1970 base.

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